

MACHINERY

Editor
CHARLES O. HERB

Associate Editors
FREEMAN C. DUSTON
CHARLES H. WICK

Book Editor
HOLBROOK L. HORTON

VOLUME 58

MAY, 1952

NUMBER 9

The Monthly Magazine of Engineering and Production
by the Manufacturers of Metal Products

SHOP PRACTICE

- Producing Gear Assemblies for Automatic Tank Transmissions
By Harry L. Whitmer 137
- Lapping—A Skilled Art Becomes a Production Process
By Stephen Hawxhurst 143
- Magnesium Die-Casting in a Pacific Coast Shop
By Gilbert C. Close 148
- Brazing the Modern Way
By Lester F. Spencer 161
- Machining and Assembling Thermosetting Laminated Plastics
By William I. Beach 172
- How Oils Should be Used in Metal-Cutting and Grinding
By Lee Ballard 182
- Sources of Lathe Vibration Located Electronically 193

MACHINE AND TOOL DESIGN

- Welded Construction Simplifies Drilling and Reaming Fixture
By E. W. Obringer 152
- Unique Designs of Progressive Press Tools
By R. Kirchner and G. V. Bevan 154
- Mechanism that Produces an Intermittent Rotary Motion
By L. A. Erickson 185
- Automatic and Continuous Feed for Form-Grinding Blades
By B. Spector 186
- Rethreading Attachment for Removing Burrs after Slotting
Threaded Work
By B. P. Fortin 189
- Multiple Measuring Blocks Facilitate Set-Up and Inspection
By Walter M. Thoryk 190
- Fixture for Multiple Form-Grinding with Crush-Dressed Wheels
By Robert W. Newton 190
- Slitting Die of Sectional Construction
By Federico Strasser 191
- Cross-Sections and Pitch Lengths of Standard V-Belts (Data
Sheet) 237

MANAGEMENT PROBLEMS

- Keeping up with Washington
By Loring F. Overman 133
- This Age of Precision
By Charles O. Herb 135
- Better Quality, Less Inspection with Sequential Sampling Plans
By Norbert L. Enrick 168
- Machine Tool Electrification Forum 188
- The Sales Engineer and His Problems—Are We Working on
Projects?
By Bernard Lester 195

DEPARTMENTS

- | | | | |
|-----------------------------|-----|------------------------------|-----|
| Keeping up with Washington | 133 | The Sales Engineer | 195 |
| In Shops Around the Country | 166 | The Latest in Shop Equipment | 196 |
| Materials of Industry | 180 | Between Grinds | 231 |
| Ingenious Mechanisms | 185 | News of the Industry | 232 |
| Tool Engineering Ideas | 189 | Data Sheet | 237 |
| New Catalogues | 247 | | |

Product Directory
261



Advertisers Index
431-432

Published Monthly By
THE INDUSTRIAL PRESS
48 Lafayette St., New York 13, N. Y.

ROBERT B. LUCHARS
President

EDGAR A. BECKER
Vice-President and Treasurer

HAROLD L. GRAY
Secretary and Publishing Manager

Advertising Representatives
WALTER E. ROBINSON
DWIGHT COOK
48 Lafayette St., New York 13, N. Y.

GEORGE H. BUEHLER
228 N. LaSalle St., Chicago 1, Ill.

NORMAN O. WYNKOOP, Jr.
17597 James Couzens Highway
Detroit 35, Mich.

DON HARWAY & COMPANY
709 W. Eighth St., Los Angeles 17, Calif.

Subscription Rates: United States and
Canada, one year, \$4; two years, \$7;
three years, \$8; foreign countries, one
year, \$7; two years, \$13. Single copies,
40 cents. Changes in address must be
received by the fifteenth of the month
to be effective for the next issue. Send
old as well as new address. Copyright
1952 by The Industrial Press. Entered
as second-class mail matter, September,
1894, at the Post Office, New York,
N. Y., under the Act of March 3, 1879.
Printed in the United States of America.

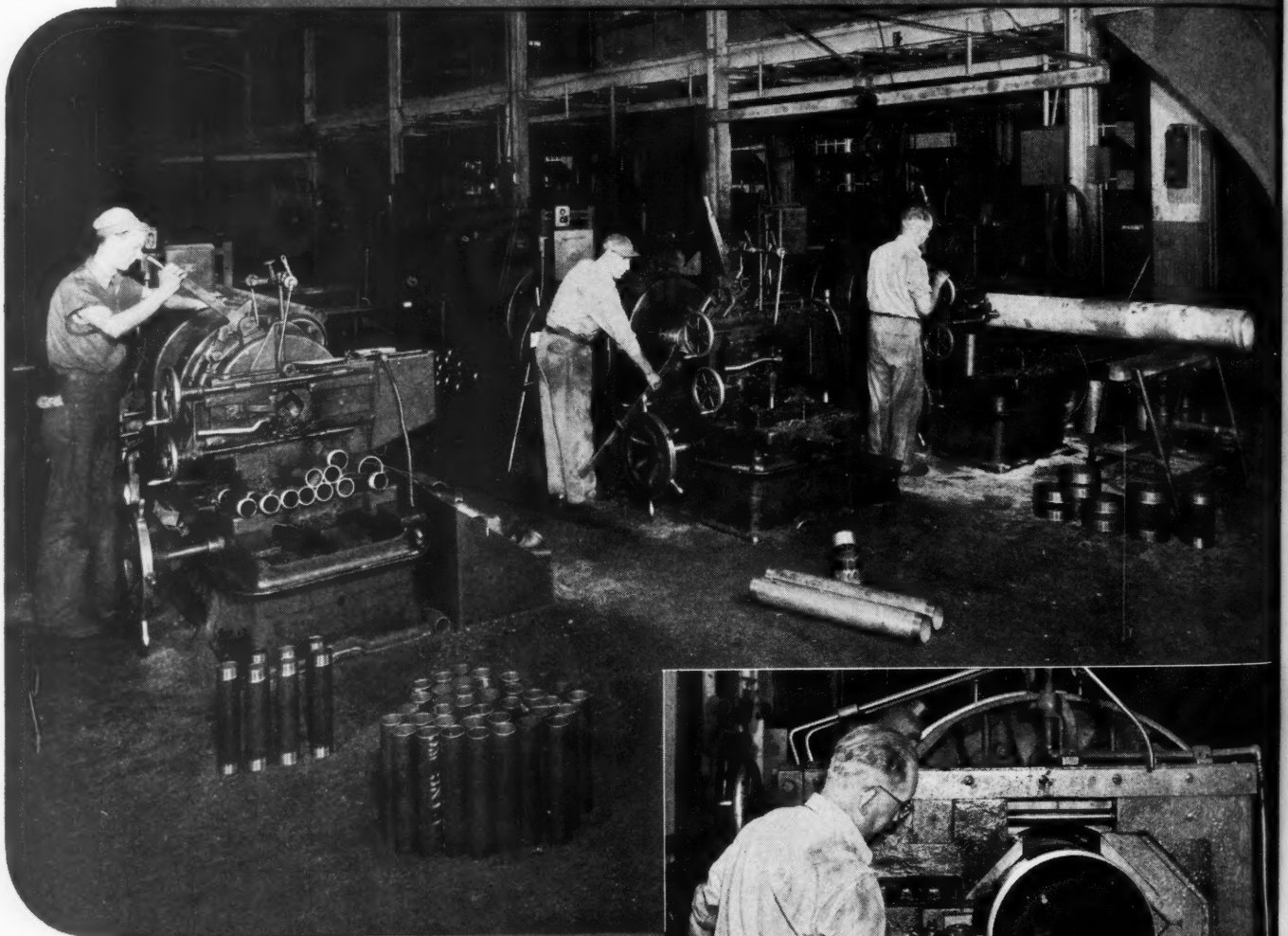
British Address:
National House, West St.
Brighton 1, England

Total Distribution
for April, 24,635

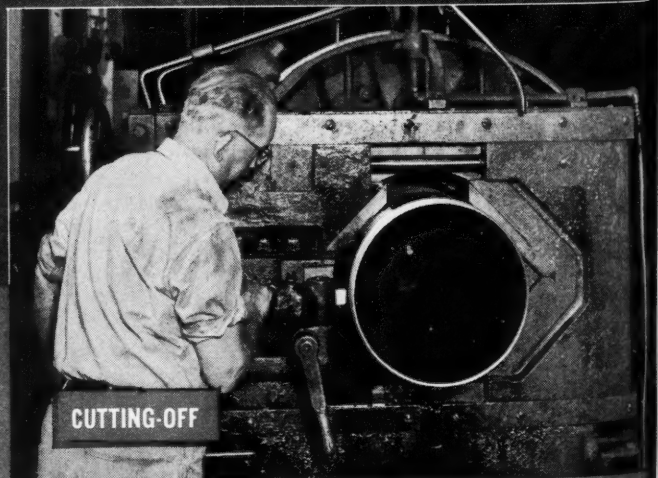


LANDIS PIPE

...Four

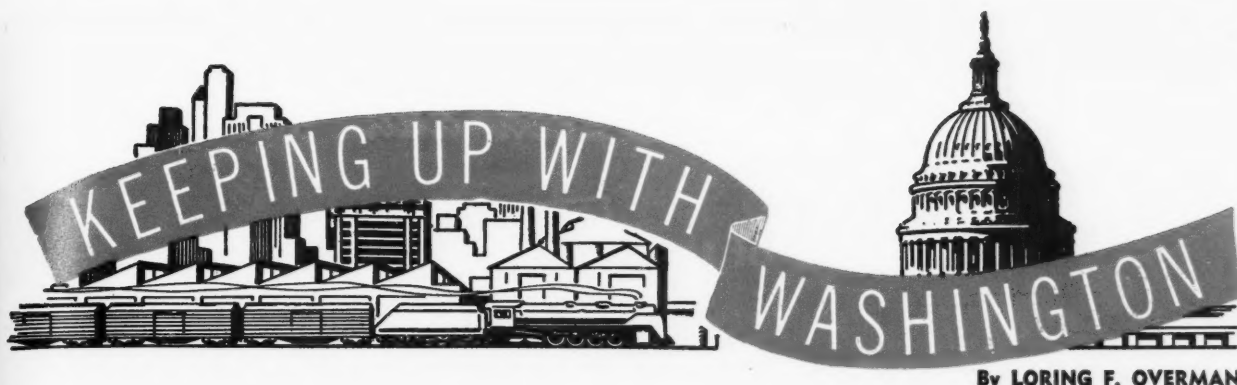


● Illustrations feature operations of an installation of LANDIS Pipe Machines in a large Detroit Plant.



LANDIS Machine

... THE WORLD'S LARGEST EXCLUSIVE



Machine Tool Commission Proposed to Expedite Deliveries

THE way things begin to look in Washington, the Controlled Materials Plan may soon have come and gone, with the machine tool shortage program still unsolved.

At press time, the machine tool industry had just come through one of those popular adventures, a full-scale investigation before a properly authorized sub-committee of the Senate Small Business Committee. But unlike some who have appeared at such hearings, the industry did not fare too badly. True, the industry could not claim that it had been able to make overnight deliveries of all the machines required. But there were friends in court to testify that the industry has quadrupled its pre-Korean production, and that it might have done even better had the military forces known their own needs in time to put the machine tool manufacturers to work supplying them.

POOL orders, sub-contracting, super-priorities, and half a dozen other procedures have been only partly successful in building up the production of machine tools. Newest device is to be a Machine Tool Commission, empowered to expedite deliveries through a revised Order M-41.

It was Clay P. Bedford, special assistant to the Secretary of Defense, who told the sub-committee of the Commission Plan, and of the travails of the industry in trying to do its best for the defense program in the face of uncertainty and, in some instances, lack of understanding on the part of those holding the reins.

Mr. Bedford told the sub-committee that the machine tool industry should have received concrete assistance and encouragement immediately after the outbreak of hostilities in Korea. That was the time, he said, when the Government should have stepped in and helped the industry.

The Office of Price Stabilization came in for special criticism for not displaying "any willingness to solve what to machine tool builders was a very big problem"—that of low prices, wages, understaffing, and marginal financial shape of the industry.

Mr. Bedford observed that it is a tribute to the industry that it was able to double its production between July, 1950, and July, 1951, and to continue the climb at as steep a rate as in World War II. He explained that the large reserve of machine tools held in moth balls after World War II left with defense planners the impression that the machine tool shortage would be nowhere nearly as acute as during the war. This, coupled with uncertainty on the part of military forces as to the models of weapons to be decided upon—and the inability of machine tool makers to proceed without such assurance—helped lead to the present crisis.

PURPOSE of the Machine Tool Commission is to develop an expediting program to move fast as soon as each production schedule is readied. The Commission is intended, among other duties, to supply the Defense Department with additional personnel to review the machine tool supplies now on hand; to aid management of the machine tool pool, and to help screen the types of machine tools for programs needing only a few critical machines to get into production.

Revision of Order M-41 (regulating the delivery of metal-working machines) will enable the industry to act quickly without going through endless channels. The new order is expected to lift machine tool production out of the materials scramble by assigning it a top number in a multi-band priority system similar to that in operation during World War II. Planners insist that it is not intended that such multi-banding will be extended to other limitation orders or to the control of materials.

WITH official Washington still puzzling over the machine tool problem, a lot of talk was going on about discontinuing the Controlled Materials Plan. It was difficult to tell how much was pre-election talk, but no effort was being made to scotch rumors that steel should be out from under controls by the fourth

quarter; that aluminum should follow shortly; and that copper would not be far behind. Explanation was that facilities production programs were proceeding at a most satisfying pace; that the military was not consuming as much metal as had been anticipated, and that even private industry had found its forecasts too optimistic.

ODDLY enough, although there is much cheery talk about supplies being so plentiful that CMP may be permitted to expire, Secretary of Commerce Sawyer is still plugging for further expansion of the aluminum facilities program. From Mr. Sawyer's explanation, it appears that the idea of abandoning CMP is predicted on the assumption that the cold war will continue. Planners concede this, but Secretary Sawyer points out that even under the so-called "stretch out" of cold-war defense preparation, the production lines have not yet begun to roll at the pace that will soon be required.

For example, the so-called J-65 program at General Motors calls for 7298 machine tools of various kinds. Of these 1140 have been received and are being set up, while 6158 remain undelivered. When this line gets moving—if ever—a lot of metal is going to be required. In addition, there is a so-called CD850 program at Buick calling for 2859 metal shaping tools, only 1988 of which have been delivered.

In view of the imminence of such heavy consumption, it is difficult to see how the doling out of metals can be abandoned with assurance at any early date. And when it is remembered that movement of the jet-engine production lines should signal the start of the 900-plane-a-month production, with its corresponding heavy demand for aluminum, perhaps Secretary Sawyer is right in wondering where such supplies are to come from. The 900-plane program is scheduled to continue until about the middle of 1955. Barring a major war, the schedule would then drop to about 500 planes a month.

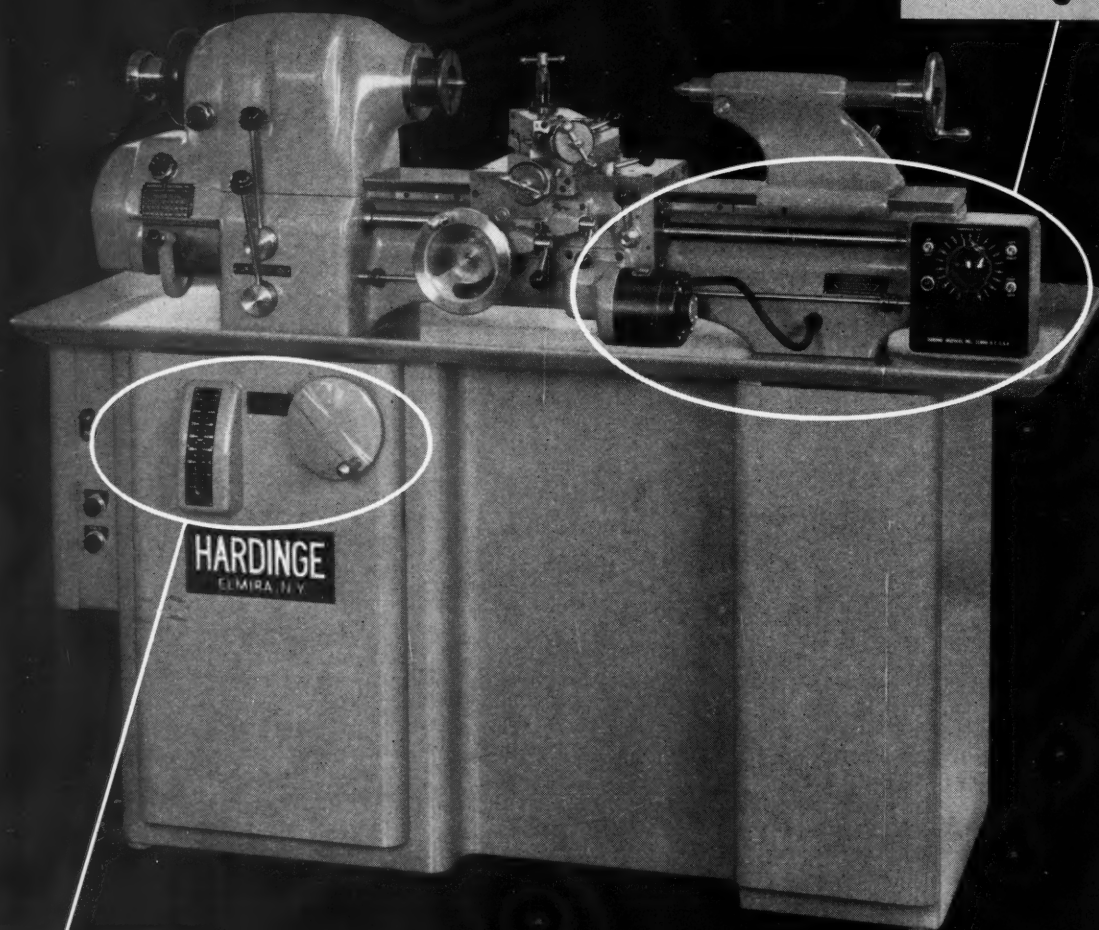
Infinite Control of Speed and Feed

is a feature of the



Tool Room and Production Lathe

Variable Feed Drive
for Carriage
and Cross Slide



Variable Speed Drive
for
Headstock Spindle

Both drives are independent and infinitely variable to secure every possible combination of speeds and feeds within the following range:

Variable Speeds: 125 to 3000 r.p.m.

Variable Feeds: $\frac{1}{4}$ " to 7" per minute

Write HARDINGE for Bulletin HLV

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

OFFICES IN PRINCIPAL CITIES. Export Office: 269 LAFAYETTE STREET, NEW YORK 12, N. Y.

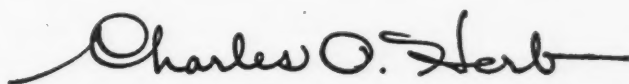
This Age of Precision

NEVER before in the history of industry has there been such a great demand for manufacturing accuracy and for quick, efficient means of insuring that mechanical parts will be produced within prescribed dimensional tolerances. That is the reason why such a large proportion of the exhibits seen at the recent Tool Engineers' Show in Chicago consisted of gaging equipment.

Of particular interest were the devices that have been developed to meet the manifold inspection problems that arise in connection with our program of manufacturing for national defense. There were, for example, gages of the electrical type, with series of contact points for checking instantaneously a dozen dimensions and angles of turbine blades for jet engines. In these gages, inaccuracy of any dimension is immediately indicated by a red light.

Another device employed electrical contacts for inspecting seventeen external dimensions of a cartridge case. Still another electrical checking fixture inspected all important dimensions of projectile heads at the rate of 2000 per hour, and automatically sorted them according to whether they were within the specified tolerances or were over size or under size. Dial gages actuated by electrical means enabled estimated readings to within two-millionths of an inch on a scale graduated to two hundred-thousandths of an inch. Optical devices of wide variety, as well as the conventional hand types of gaging equipment, completed the displays devoted to inspection devices.

Inspection equipment of the caliber exhibited at the Show reflects the high degree of ingenuity constantly being applied by industrial designers to expedite the manufacture of mechanical products.


EDITOR



Cold water strikes red hot metal in end-quench hardenability test—first step in Ryerson quality control.

RED HOT REASON for Buying Ryerson Alloys

There is no question about it—our end-quench hardenability tests certainly simplify your job of buying and heat treating today's interim and lean alloys. With the hardenability of your particular steel thus definitely determined, the other mechanical properties can also be predicted—with confidence.

These hardenability tests are but one step in a unique program that makes Ryerson alloys easier to buy and safer to use. Starting with careful selection of every heat carried in Ryerson stock, the plan follows clear through to the certification of analysis and hardenability that is sent with every shipment of as-rolled or annealed Ryerson alloy steel.

Now more than ever this Certified Plan makes Ryerson your best source for alloys. Though defense

demands are taxing even our extensive facilities we can undoubtedly take care of most of your requirements. So for quick shipment of pre-tested alloy steels which you can buy and heat treat with confidence, call the nearest Ryerson plant. And remember we also carry heat treated alloys in stock for immediate shipment.

PRINCIPAL PRODUCTS

CARBON STEEL BARS—Hot rolled & cold finished

STRUCTURALS—Channels, angles, beams, etc.

PLATES—Many types including Inland 4-Way Safety Plate

SHEETS—Hot & cold rolled, many types & coatings

TUBING—Seamless & welded, mechanical & boiler tubes

ALLOYS—Hot rolled, cold finished, heat treated

STAINLESS—Allegheny bars plates, sheets, tubes, etc.

TOOL STEEL—Oil and water-hardening types, ground flat stock

REINFORCING—Bars & Accessories, spirals, wire mesh

MACHINERY & TOOLS—For metal fabrication

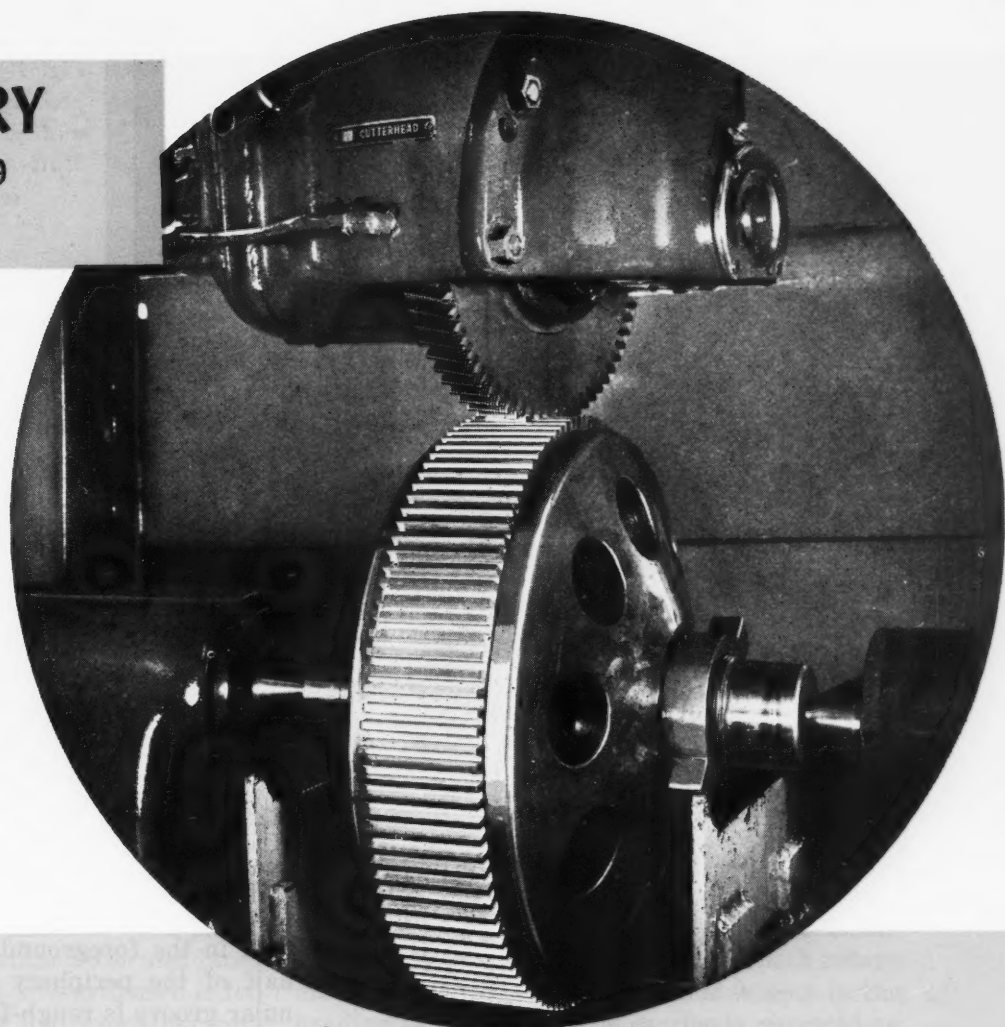
RYERSON STEEL



JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • CINCINNATI • CLEVELAND • DETROIT
PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

MACHINERY

Vol. 58 No. 9
MAY, 1952



Producing Gear Assemblies for Automatic Tank Transmissions

By HARRY L. WHITMER, Master Mechanic
Chevrolet-Saginaw Transmission Division
General Motors Corporation
Saginaw, Mich.

CHEVROLET'S transmission plant in Saginaw, Mich.—one of the key plants in World War II production—is again busy turning out urgently required defense items. Within four months from the receipt of a contract, this plant began to turn out gear assemblies for automatic transmissions used in the Army's new light tank—the "Walker Bulldog."

Approximately 90 of the 670 parts in this 2400-pound automatic tank transmission are produced on about 600 machines at this plant. Since the transmission is subjected to high pressures

and temperatures in combat, specialized manufacturing procedures are required and extremely close tolerances must be maintained. Many of the tank transmission gears are relatively large and have thin cross-sections, which complicates their manufacture and makes it more difficult to maintain the required aircraft quality and tolerances.

The output planet carriers for the automatic tank transmission are turned, bored, faced, and grooved in two operations on the Bullard eight-spindle Mult-Au-Matic machine shown in Fig. 1.



Fig. 1. Steel forgings weighing 95 pounds are turned, bored, faced, and grooved on an eight-spindle Mult-Au-Matic. Finished parts weigh only 37 pounds.

Fig. 2. Pinion pockets, $3 \frac{15}{16}$ inches in diameter and $1 \frac{9}{32}$ inches deep, are drilled on this heavy-duty, hydraulically fed machine.



Approximately 58 pounds of chips are removed from the 95-pound, S A E 8740 steel forgings seen in the foreground. In the first operation, half of the periphery is rough-turned, an annular groove is rough-formed, the lug surface is faced, and the center hole is bored.

The forgings, which are $14 \frac{1}{2}$ inches in diameter by $2 \frac{7}{8}$ inches thick, are held by three-jaw, power-operated chucks provided at each of the eight stations. Completed parts are removed and forgings are loaded at the first station, seen at the left in the illustration. Four carbide-tipped tool bits are mounted at the second station to rough-bore the center hole, rough-turn half of the periphery, and rough-face the lug surface. This lug surface is semi-finish-faced and the edge of the forging is rough-faced by means of three tools held in the third station. Two tools are provided at each of the three subsequent stations to rough-form the annular groove, which is approximately $13 \frac{1}{8}$ inches in diameter by $15/16$ inch wide and $2 \frac{3}{8}$ inches deep.

At the seventh station, the edge of the carrier forging and the lug surface are finish-faced by means of two more tools. Three tools at the eighth station are used to semi-finish-bore the center hole, semi-finish-turn half of the periphery, and finish-form the annular groove. The forgings are rotated at 70 R.P.M.—providing surface speeds of about 90 feet per minute in boring and 260 feet per minute in turning the periphery—while the tools are fed at the rate of 0.015 inch per revolution.

Fig. 3. Output planet carriers for the automatic tank transmission are completely machined on machines seen in Figs. 1 and 2.



Pinion pockets are drilled in the forged steel output planet carriers on the Baker hydraulic, heavy-duty drilling machine illustrated in Fig. 2. Each of the four pinion pockets is $3 \frac{15}{16}$ inches in diameter by $1 \frac{9}{32}$ inches deep. The work-pieces, Fig. 3, are clamped, one at a time, on a four-station indexing table mounted on the bed of the machine. The drills are rotated at 71 R.P.M., giving a cutting speed of approximately 73 feet per minute. A previously drilled hole, $\frac{23}{32}$ inch in diameter, is used for radial location of the pinion pockets, and the work-pieces are located on their bored center holes and faced lower surfaces. The special core-drill used is fed into the work at the rate of 0.016 inch per revolution. Flat plug gages are employed to check the diameter of the pinion pockets, and flush-pin gages to inspect the depth.

Teeth are hobbled in the periphery of the output planet carrier on a battery of ten Cleveland single-spindle hobbing machines, five of which can be seen in Fig. 4. The 112 spur gear teeth,

of 8 pitch, have a 10-degree pressure angle and a pitch diameter of 14.000 inches. In the rough cut, the 3-inch diameter hob is rotated at 105 R.P.M. (82.7 feet per minute) and fed at 0.0007 inch per revolution, while the work revolves at 1.92 R.P.M. During finishing, the hob is rotated at 112 R.P.M. (88 feet per minute) and fed at 0.0006 inch per revolution while the work revolves at 2.04 R.P.M. The work is located from the same surfaces as in the previous drilling operation.

To obtain greater accuracy and better finish, the teeth are shaved on a National Broach rotary machine, a close-up view of which is seen in the heading illustration. The carrier is mounted on an arbor, supported between head- and tail-centers, and is driven by a seventy-one-tooth shaving cutter, $8 \frac{7}{8}$ inches in diameter, which rotates at 241 R.P.M. (560 feet per minute). The table on which the work is mounted is reciprocated below the skewed axis of the cutter at the rate of 2.04 inches per minute, and the cutter is



Fig. 4. Five single-spindle hobbing machines are employed to cut 112 teeth in the periphery of the output planet carriers.

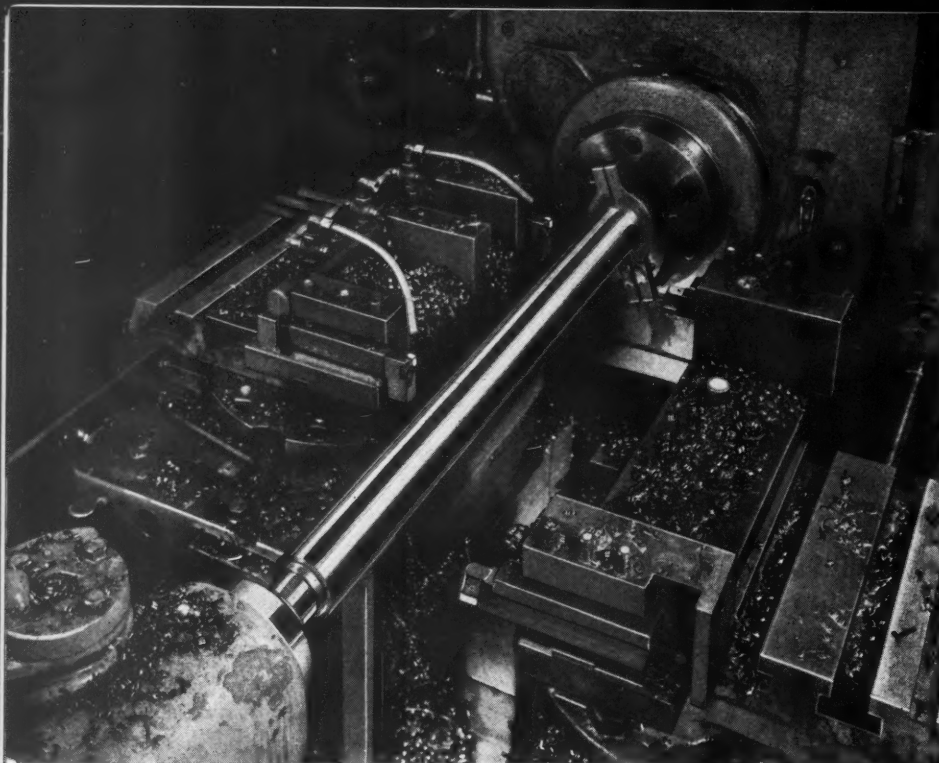


Fig. 5. Two solid carbide tool bits on the front slide and two carbide-tipped tools on the rear slide are employed to turn the main cross-drive shafts.

fed downward 0.002 inch at each reversal of the table. The cutting cycle is completely automatic. When the shaved teeth of the carrier are meshed with a master gear between standard centers, backlash must not exceed 0.003 inch.

Main cross-drive shafts for the automatic tank transmissions are rough- and semi-finish-turned on the Lodge & Shipley Duomatic lathe seen in Fig. 5. The long, slender shafts, approximately 2 1/2 inches in diameter by 27 3/4 inches long, are held between head- and tail-centers, with a driving dog clamped to the head-center end to

rotate the shafts at 768 R.P.M. (about 450 feet per minute).

Two solid carbide tools having a square cross-section are clamped in holders on the front slide of the machine, while two carbide-tipped tools are held on the rear slide. Maximum depth of cut is about 3/16 inch, and the tools are fed at the rate of 0.023 inch per revolution. Shaft size is maintained within a tolerance of ± 0.0025 inch in this operation.

An unusual feature in the manufacture of this part is that the shafts are hardened to about 34



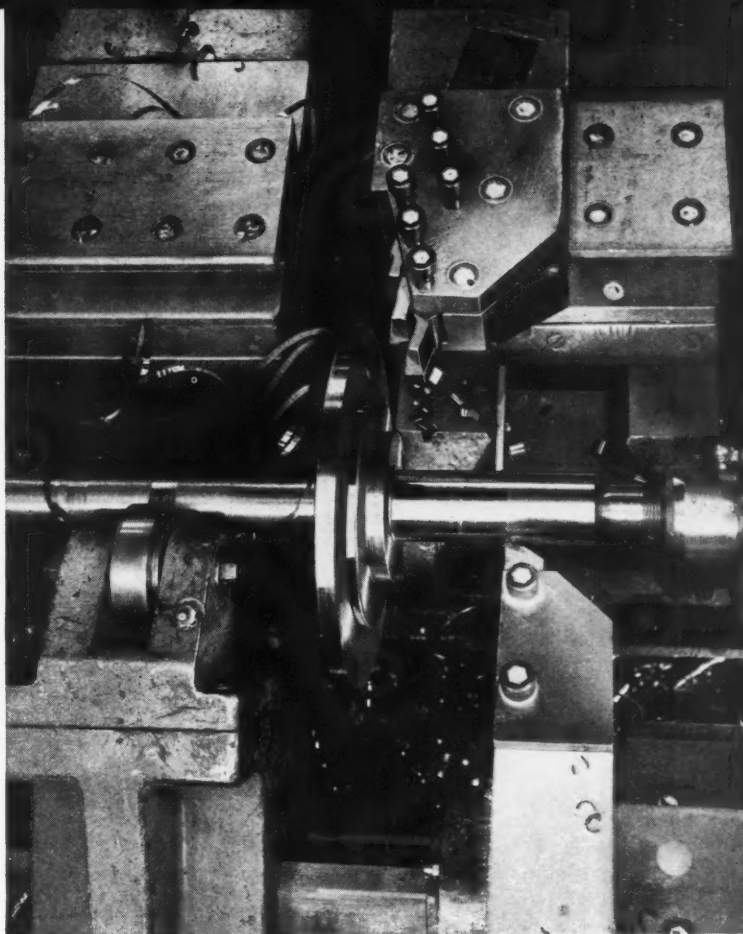
Fig. 6. Inner hubs for the tank transmission steering clutch are drilled, countersunk, spot-faced, counterbored, and reamed on an eight-station machine.

Fig. 7. Multiple-diameter flange on the steering clutch drive-shaft is turned and faced and the 5-inch long stem on one end of the shaft is turned in the set-up here illustrated.

Rockwell C prior to finish-machining, in order to prevent subsequent distortion and insure that the required accuracy is maintained.

On the Buhr eight-station, multiple-spindle machine illustrated in Fig. 6, forty holes in the aluminum-alloy inner hub for the steering clutch of the automatic tank transmission are drilled, countersunk, spot-faced, counterbored, and reamed. The eight heads hold a total of seventy-two tools, which are fed at the rate of 0.002 inch per revolution. After loading at the first station, the cast hub is indexed to the second station, where a hole $2 \frac{1}{64}$ inches in diameter is drilled to a depth of $1 \frac{3}{16}$ inches, and four holes $11/64$ inch in diameter are drilled $1/4$ inch deep. A thirteen-spindle head at the third station holds a $19/64$ -inch drill and twelve drills $11/64$ inch in diameter.

When the hub has been indexed to the fourth station, the thirteen holes drilled in the previous station are deepened. Special counterboring tools are mounted on the heads at the fifth and sixth stations, while reamers are used at the seventh and eighth stations. Special drills with deep, well polished flutes, narrow margins, and large spiral angles are employed for drilling this cast-aluminum part. The tools are rotated at 804



R.P.M. Location of six of the holes must be held within ± 0.0005 inch.

Drive-shafts for the steering clutch are turned and faced on a Seneca Falls Lo-Swing lathe, Fig. 7. The shafts, approximately 20 inches long by 2 inches in diameter, with a multiple-diameter flange 5 inches from one end, are held in the



Fig. 8. Pinion-shaft holes in the low-gear planetary carrier assembly are precision-bored within a total tolerance of 0.0005 inch in this set-up.

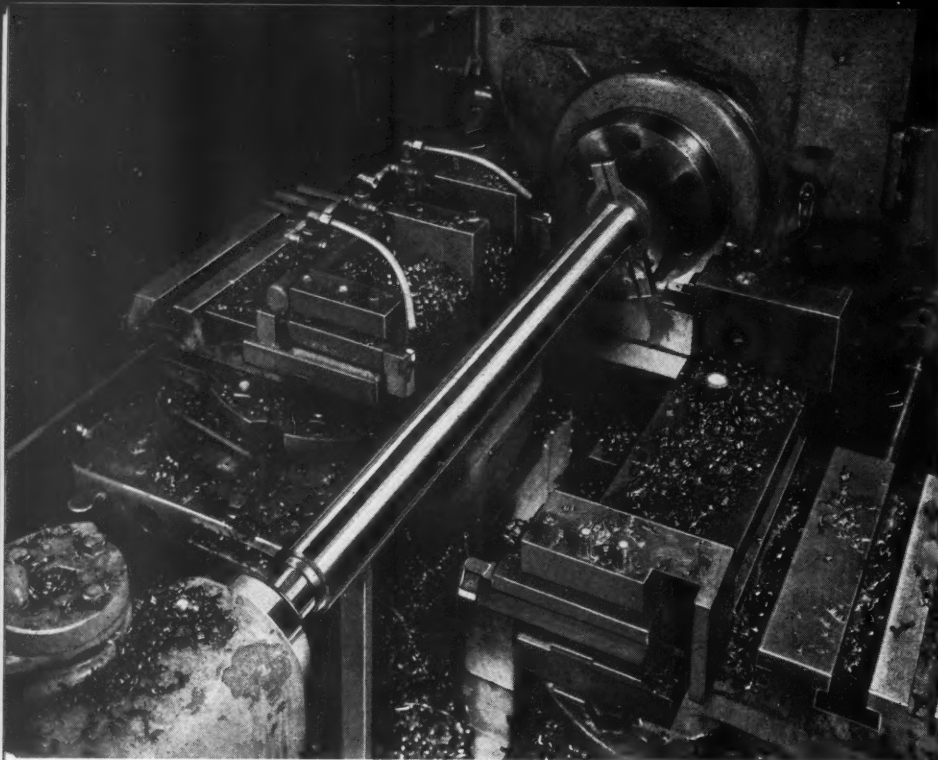


Fig. 5. Two solid carbide tool bits on the front slide and two carbide-tipped tools on the rear slide are employed to turn the main cross-drive shafts.

fed downward 0.002 inch at each reversal of the table. The cutting cycle is completely automatic. When the shaved teeth of the carrier are meshed with a master gear between standard centers, backlash must not exceed 0.003 inch.

Main cross-drive shafts for the automatic tank transmissions are rough- and semi-finish-turned on the Lodge & Shipley Duomatic lathe seen in Fig. 5. The long, slender shafts, approximately 2 1/2 inches in diameter by 27 3/4 inches long, are held between head- and tail-centers, with a driving dog clamped to the head-center end to

rotate the shafts at 768 R.P.M. (about 450 feet per minute).

Two solid carbide tools having a square cross-section are clamped in holders on the front slide of the machine, while two carbide-tipped tools are held on the rear slide. Maximum depth of cut is about 3/16 inch, and the tools are fed at the rate of 0.023 inch per revolution. Shaft size is maintained within a tolerance of ± 0.0025 inch in this operation.

An unusual feature in the manufacture of this part is that the shafts are hardened to about 34



Fig. 6. Inner hubs for the tank transmission steering clutch are drilled, countersunk, spot-faced, counterbored, and reamed on an eight-station machine.

Fig. 7. Multiple-diameter flange on the steering clutch drive-shaft is turned and faced and the 5-inch long stem on one end of the shaft is turned in the set-up here illustrated.

Rockwell C prior to finish-machining, in order to prevent subsequent distortion and insure that the required accuracy is maintained.

On the Buhr eight-station, multiple-spindle machine illustrated in Fig. 6, forty holes in the aluminum-alloy inner hub for the steering clutch of the automatic tank transmission are drilled, countersunk, spot-faced, counterbored, and reamed. The eight heads hold a total of seventy-two tools, which are fed at the rate of 0.002 inch per revolution. After loading at the first station, the cast hub is indexed to the second station, where a hole $2 \frac{1}{64}$ inches in diameter is drilled to a depth of $1 \frac{3}{16}$ inches, and four holes $11/64$ inch in diameter are drilled $1/4$ inch deep. A thirteen-spindle head at the third station holds a $19/64$ -inch drill and twelve drills $11/64$ inch in diameter.

When the hub has been indexed to the fourth station, the thirteen holes drilled in the previous station are deepened. Special counterboring tools are mounted on the heads at the fifth and sixth stations, while reamers are used at the seventh and eighth stations. Special drills with deep, well polished flutes, narrow margins, and large spiral angles are employed for drilling this cast-aluminum part. The tools are rotated at 804

R.P.M. Location of six of the holes must be held within ± 0.0005 inch.

Drive-shafts for the steering clutch are turned and faced on a Seneca Falls Lo-Swing lathe, Fig. 7. The shafts, approximately 20 inches long by 2 inches in diameter, with a multiple-diameter flange 5 inches from one end, are held in the

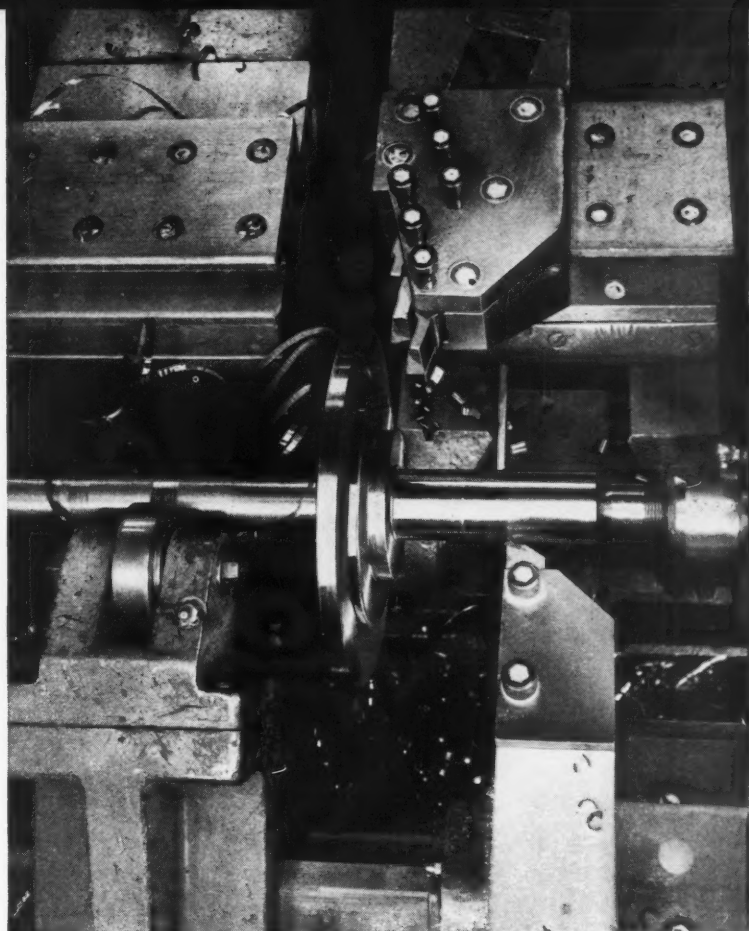


Fig. 8. Pinion-shaft holes in the low-gear planetary carrier assembly are precision-bored within a total tolerance of 0.0005 inch in this set-up.



Fig. 9. Internal teeth of the low outer-drive gear are ground to improve their accuracy and surface finish and to minimize backlash.

lathe between head- and tail-centers, with a two-jaw floating chuck gripping one end. Three rollers and three pins are held in contact with the long, slender shaft to steady it. The shafts are forged from S A E 4340 steel.

A single-point, carbide-tipped tool, held in the front tool-block, turns the 5-inch long stem on one end of the steering clutch drive-shaft to a diameter of 1.821 inches. The rear tool-block holds three carbide-tipped tools, set at an angle, to turn and face three shoulders on the 9-inch diameter flange. With the work rotating at 183 R.P.M., a minimum cutting speed of 87.5 feet per minute is employed in turning the stem, and a maximum speed of 302 feet per minute in turning the largest diameter on the flange. All of the tools are fed at 0.0125 inch per revolution.

An outstanding example of precision machining is the boring of four pinion-shaft holes in the low-gear planetary carrier assembly. The planetary gears of this assembly rotate on needle bearings mounted on ground pinion-shafts, which are supported between two steel plates. As it is essential that the shafts be parallel and accurately spaced, the pinion-shaft holes must be bored within close tolerances. The holes in the rear plate of the assembly are in line with those in the front plate, but separated from them by an air space of 1 1/8 inches. Both plates are steel alloy forgings.

This precision boring operation is performed on the Ex-Cell-O single-end, single-spindle boring machine shown in Fig. 8. A special manually-operated work-holding and indexing fixture is employed to insure accurate radial location of the holes. Approximately 0.020 inch of stock is bored from each hole, the single-point, carbide-tipped boring tool being rotated at 1300 R.P.M.

(384 feet per minute) and fed at the rate of 0.0039 inch per revolution.

The pinion-shaft holes are held within ± 0.00025 inch of the required size, being bored to a diameter between 1.1297 and 1.1302 inches. A Sheffield "Precisionaire" double-column air gage is used to inspect the size of the holes in both front and back plates of the planetary carrier assembly. Parallelism and center distances of the holes are also maintained within 0.00025 inch, and their concentricity is not permitted to vary more than 0.0005 inch per inch of length.

Another extremely accurate operation required in manufacturing parts for the automatic tank transmission is the grinding of the internal teeth in the low outer-drive gear. This operation is performed on a Detroit internal gear grinding machine, Fig. 9. The sixty-two internal teeth (6 pitch) have a 25-degree pressure angle and a pitch diameter of 10.3333 inches. A six-jaw diaphragm chuck is employed to grip the gear, locating from the previously ground back face and the external teeth.

A vitrified-bond, aluminum-oxide abrasive wheel, of 60 grain size and J hardness, is employed. The wheel, which is 4 1/2 inches in diameter by 7/16 inch wide, is rotated at 4500 surface feet per minute, and successively hand-fed 0.002, 0.0015, and 0.001 inch after each complete indexing of the gear. The reciprocating table travels at 345 inches per minute. After grinding, the pitch diameters of the internal and external teeth must be concentric within ± 0.001 inch. Arc tooth thickness of the internal teeth at the pitch line is held to ± 0.0005 inch, and backlash must not exceed 0.002 inch when the ground internal teeth are meshed with a master gear mounted between standard centers.

Lapping—A Skilled Art Becomes a Production Process

Stock Removal Rates, Work Separators and Fixtures, Cleaning and Polishing of Lapped Parts, and Examples of Modern Production Lapping are Described in This Article, the Second of Two Installments

By **STEPHEN HAWXHURST**
Lapmaster Division
Crane Packing Co.
Chicago, Ill.

FUNDAMENTALS of the lapping process, the need for modern production lapping, the operation of the Lapmaster machine, choice of abrasive and vehicle, and the flatness, surface finish, and parallelism obtainable in lapping were discussed in the first installment of this article, which was published in the April number of **MACHINERY**. In this installment—the concluding one—stock removal rates, work separators and fixtures, cleaning and polishing of lapped parts, and examples of modern production lapping are described.

Lapping is principally a surface refining operation, and is seldom employed as a size generating process. Only minor dimensional errors can be corrected by this process without lengthening the lapping cycle excessively. Parts can be measured periodically during lapping, and in this way, size can be maintained accurately. Such a procedure, however, slows down the operation, particularly where close tolerances are required. Once a definite time cycle is established, and identical lapping conditions are consistently repeated, fairly accurate dimensions can be maintained on the work.

The rate at which stock can be removed in lapping is extremely variable, depending upon all the factors affecting surface finish (mentioned in the preceding installment), in addition to the



Fig. 7. One face of seal-diaphragm assemblies is lapped in this set-up. The rubber diaphragms rest on the work separator.

hardness of the abrasive, the surface speed of the lapping plate, and the required finish on the work. At the beginning of the operation, only high spots on the work-pieces contact the lapping plate; consequently, unit pressures and stock removal rates are higher than when the surfaces become flat.

As previously mentioned, silicon-carbide abrasive is slightly harder than aluminum oxide, and will cut faster, but it produces a rougher finish for the same grain size. Pressure of the surface being lapped against the lapping plate has an important effect on both the rate at which stock is removed and the smoothness of the surface produced. Such pressure should be at a minimum when lapping the softer materials.

Since there are so many variables, it would be impossible to tabulate stock removal rates for different materials under all conditions. How-

ever, the accompanying table will give some idea of the comparative rates for a few materials under one set of conditions. These results were obtained on work-pieces 1 1/2 inches in diameter, using 800-grit aluminum-oxide abrasive.

It can be seen from this table that the lapping rate is twice as rapid in removing tool marks than in removing additional stock below the tool marks. This, of course, is due to the fact that less stock must be removed from the ridges formed by the tools. For this reason, many machined parts are now being lapped without grinding them first. Accurate, flat surfaces can be produced economically in this way if the surfaces are machined within fairly close tolerances.

Work separators for the Lapmaster machines are simple in design and inexpensive, usually being made from round blanks of laminated phenol-formaldehyde resins, such as Bakelite or Micarta. The separators are made about 1/16 inch smaller in diameter than the bore of the conditioning rings, and slightly thinner than the work-pieces. Openings of the same shape as the parts to be lapped are drilled or sawed in the separators to a size that will allow the parts to float slightly. The motion of the lapping plate causes the parts and separator to rotate about the vertical axis of the separator. Spring-loaded, vertical guide pins, mounted in the center of the conditioning rings and entering holes in the work separators, are sometimes employed to centralize the separators within the rings when pneumatic lifts are used.

Approximate Comparative Rates at which Stock is Removed in Lapping Various Materials

Material	Stock Removed, Inch per Minute	
	To Remove Tool or Grinding Wheel Marks	Further Stock Removal from Base Metal
Cast Iron, Gray	0.0010	0.0005
Cast Iron, Alloy (without chromium)	0.0005	0.0002
Steel, Mild (Soft)	0.0010	0.0005
Steel, Alloy (Hard) ..	0.0001	0.00005
Steel, Tool (Hard) ...	0.00002	0.00001
Steel, Stainless (18-8)	0.0001	0.00005
Bronze	0.0010	0.0005
Copper and Brass.	0.0020	0.0010
Cast Alloys (Stellite) .	0.00002	0.00001
Carbides	0.00001	0.000005
Glass and Quartz	0.0001	0.0001

In cases where pressure-plates are necessary, the separators can sometimes be attached to the under sides of these plates. Also, if the work-pieces are light, they can be held on the plates—for loading and unloading—by applying a light film of oil or a coat of grease.

Production in lapping can be increased by providing an extra set of separators, Fig. 7. In this way, one set can be unloaded and reloaded while parts in the other set are being lapped. In the operation shown, which is performed on a 24-inch Lapmaster, one face of seal-diaphragm assemblies is being lapped. The assembly is a two-piece metal part with a flexible rubber diaphragm that rests on the Micarta separator.

An interesting magnetic work-holding arrangement, designed for a part that was difficult to handle, is seen in Fig. 8. The operation consists of lapping a narrow, ring-shaped flat surface near the periphery of spring-steel diaphragms, 0.007 inch thick, on a 12-inch machine. A hole in the center of each diaphragm fits over a projection on the end of a permanent magnet. The magnets are attached to dowels which move freely through holes in a plate above them. A light spring on each dowel provides equal pressure on the parts. After lapping, the plate, with the magnets and diaphragms, is lifted, as a unit, from the lap, and then the lapped diaphragms can be removed from the magnets. From 0.0002 to 0.0003 inch of stock is lapped from the diaphragms in this operation.

The ends of long, slender pins, such as micrometer shafts, can be lapped flat and parallel by means of the fixture illustrated in Fig. 9. The



Fig. 8. Spring-steel diaphragms, only 0.007 inch thick, are held during lapping by means of permanent magnets.

work-pieces *A* are positioned vertically in V-notches around the periphery of a holding ring *B*, being located axially by means of a loading plate *C*, placed beneath the holding ring. A clamping ring *D*, encircling the holding ring, is then tightened by means of screw *E* to hold the work-pieces securely in place. The assembly, without the loading plate, is now placed on the lapping plate within the conditioning ring.

Another special lapping fixture, designed to hold three unbalanced air-valve bodies while lapping a small-diameter face on each body, is seen in Fig. 10. Two spring-loaded, tapered-nose guide pins *A* enter previously drilled holes in each valve body *B*. An adjustable work-holder pin *C* screwed into the cross-arm *D* on the lapping machine, exerts downward pressure on a thrust ball *E* held in a pocket in the center of the pressure-plate *F*.

After lapping, the work-pieces are cleaned to remove the lapping compound and loose material. Cleaning should be done as soon as practical after the operation, since removal of compound and grit is easier when done immediately. Conventional methods, such as solvent or alkaline cleaning by hand wiping, tank dipping, or spraying are employed for this purpose.

A simple and inexpensive method consists of placing the parts in a wire tray or basket, which is agitated in a tank of oleum spirits or carbon tetrachloride. Oleum spirits evaporate very slowly, and are considered non-explosive because of their high flash point. Pressure-spraying with oleum spirits is another effective method of cleaning lapped parts. In any case, a final cleaning should be performed by blasting with compressed air to insure removal of all compound. Cleaning is also recommended prior to lapping if the parts are dirty or covered with chips or other foreign matter.

Although many lapped parts are not polished, this supplementary operation is performed in certain cases. One reason for polishing a lapped surface is to improve its appearance. The characteristic dull, matte finish of a lapped surface can be quickly changed to a bright mirror finish by light polishing. Another reason for polishing is to permit inspection under optical flats, since a lapped surface is a poor reflector of light.

Still another reason for polishing is to remove any traces of embedded abrasive. This is required only when the lapped surface is to have relative motion with respect to a mating surface

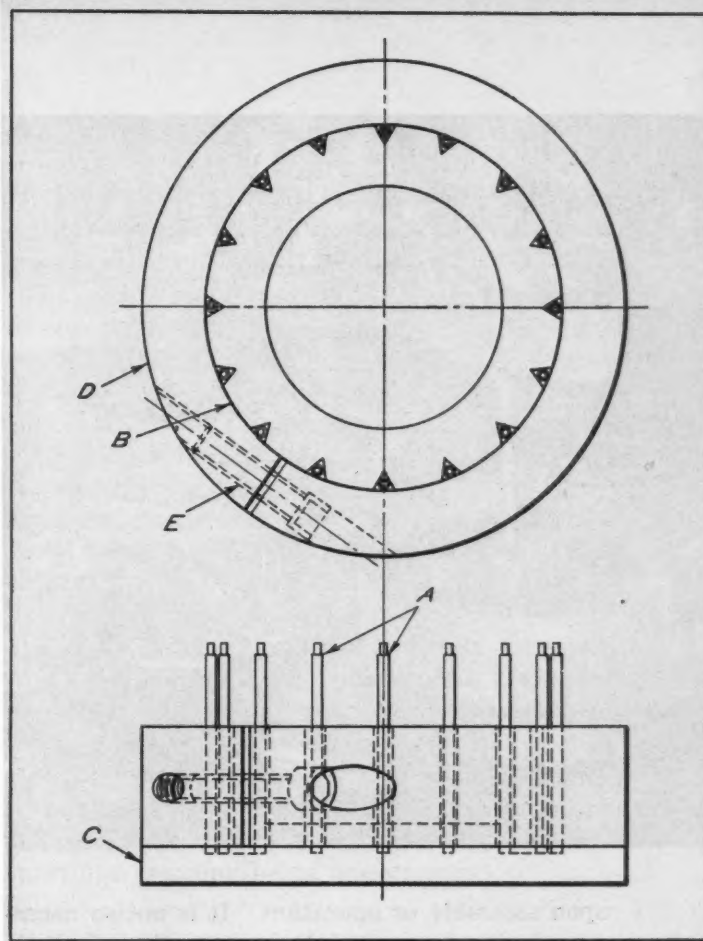


Fig. 9. Ends of long, slender pins are lapped flat and parallel by the use of this special work-holding fixture.

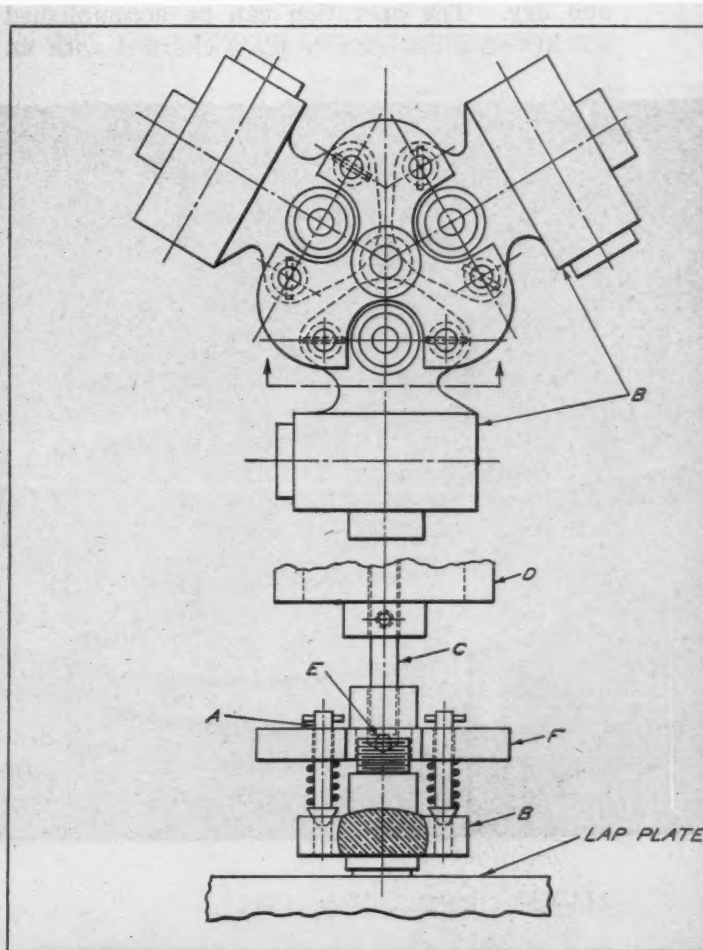


Fig. 10. Three air-valve bodies are held in the special fixture illustrated while lapping a small-diameter face on each.

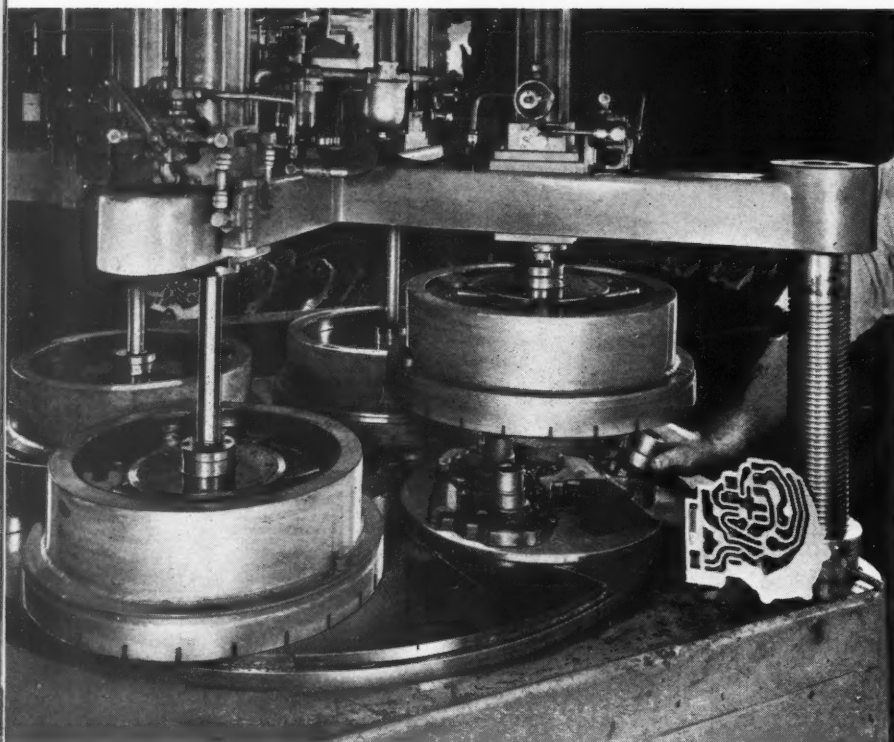


Fig. 11. Flat sealing surfaces are produced on valve bodies for an automatic transmission in the set-up here shown.

upon assembly or operation. It is not so necessary on harder materials, because there is little possibility of abrasive becoming embedded in such surfaces, but it is essential on softer materials. In general, polishing does not remove enough material to change the dimensions of a part.

Parts that require polishing should be clean and dry. The operation can be accomplished quickly on a flat surface plate charged with an

abrasive compound. The part is placed on the plate and moved with a figure-eight motion while applying gentle, even hand pressure. When the polishing plate becomes out of flat, it can be reconditioned on the lapping machine. The plate can be recharged after cleaning its surface with carbon tetrachloride or alcohol. The abrasive compound is sprinkled over the cleaned surface and wet with alcohol, after which a steel block is slid over the plate to charge it, pressure being

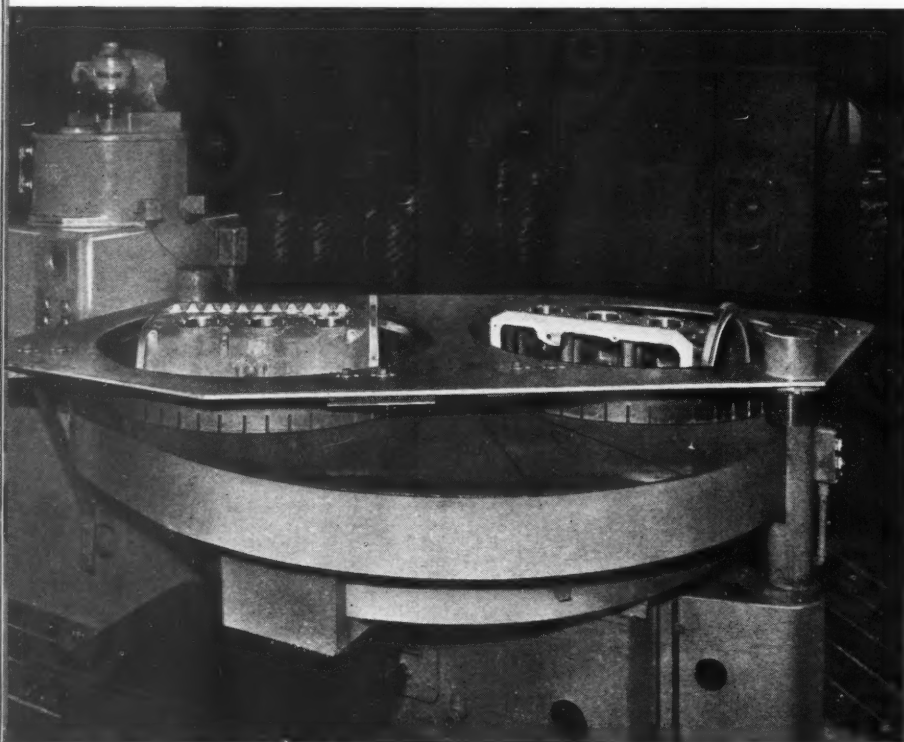


Fig. 12. An 84-inch machine is employed to lap the mating faces of cast-aluminum, aircraft type engine crankcases.

exerted and the block being moved the same as in polishing.

The importance of precision flat lapping in modern industrial production can be illustrated by a few examples. In manufacturing certain hardened, high-carbon steel valves, 3/8 inch in diameter by 1/16 inch thick, it is necessary to produce a degree of flatness that will withstand an air pressure of 2000 pounds per square inch without leakage. Prior to the acquisition of a Lapmaster machine for this job, the manufacturer had not been able to find a satisfactory and economical method of lapping these valve parts. Now the valves are being precision-lapped on each side at the rate of 195 pieces in a five-minute lapping cycle per side.

In the mass production of Chevrolet's "Power-Glide" automatic transmission, eleven parts—ranging from large cast-iron cases to small gears and pump bodies—require accurate lapping. A battery of Lapmaster machines is used for some of these operations. One such machine, Fig. 11, is employed to produce a sealing surface on the intricately cored cast-iron transmission valve

body. Each of the four work separators on this 48-inch machine accommodates three work-pieces. Specially shaped pressure-plates are used in this operation to insure an even distribution of weight on the surfaces being lapped and to shorten the lapping cycle.

One of the larger Lapmaster machines currently being used in production is the 84-inch machine illustrated in Fig. 12. On this machine, the mating faces of the halves of horizontally opposed, aircraft type engine crankcases for military tank engines made by the Continental Motors Corporation, are being lapped. These faces must be flat enough to produce an oil-tight seal when they are bolted together. Gaskets are not used. Owing to the size of the parts, each conditioning ring holds one piece, and two complete halves or one complete crankcase are finished in an eight-minute cycle. The parts are made of aluminum, and approximately 0.007 inch of stock is removed from the face, using a 600-grit silicon-carbide abrasive. Castings come to the lapping machine directly from the milling operation, previous grinding being unnecessary.

Power-brushing the teeth of airplane gears to remove burrs. The teeth were formerly rounded by hand in an operation that required 2 1/2 hours per gear. With the power brushes supplied by the Osborn Mfg. Co., the time per gear has been cut to three minutes. It is claimed that none of the hand finished gears would have passed inspection if required to meet the standards that are necessary for the brushed gears.



Magnesium Die-Casting

By
GILBERT C. CLOSE



General view showing Reed-Prentice die-casting machine with operator and inspector

ONE hundred thousand pounds is a large amount of magnesium, and when this is broken down into die-castings that weigh between one-tenth ounce and three pounds each, with emphasis on the smaller varieties, it makes a great number of parts. That is the average monthly production in the magnesium die-casting department of the McCulloch Motors Corporation, Los Angeles, Calif.

The castings produced in this plant are used mainly in portable powered chain saws and in small engines employed to propel target airplanes. Typical parts that are die-cast include crankcases and crankcase covers, gear-cases and gear-case covers, carburetors, air cleaners and covers, engine cylinders, etc. The company is now also tooling up to start the production of utility helicopters, in which magnesium die-castings are extensively used.

The new die-casting department contains fifteen die-casting machines—twelve Reed-Prentice, two Cleveland, and one Lester-Phoenix. All these machines are of the cold-chamber type, in which the molten metal is hand-ladled from a holding pot into the pressure chamber prior to each shot. The machines are of various sizes, with locking pressures of from 100 to 600 tons for holding the die halves together during injection of the metal. Injection pressures may be varied

between 5000 and 20,000 pounds per square inch. The optimum injection pressure to be used for any part is determined by the characteristics of the individual castings.

The adjustability provided by the die-casting machines is extremely important in turning out the 100 to 125 different die-castings, varying widely in weight, that are required. While considerable knowledge is available concerning magnesium die-casting, many of the finer points of production technique are derived by trial and error. A series of test parts is cast before production runs are started on any new part. During the casting of these test parts, different machine settings are used to arrive at those that will give best results. Injection pressure, injection speed, die temperature, and die lubricants are varied until the part meets the required standards.

Once the proper machine settings have been established for a part, they are recorded on a standard control procedure form. This form specifies (1) holding temperature of molten metal; (2) die lubricant; (3) die temperature (controlled by water cooling); (4) length of time die must remain closed after injection of metal to assure solidification before the part is ejected; (5) injection pressure; and (6) injection speed.

in a Pacific Coast Shop

In general, the metal holding temperature ranges between 1175 and 1250 degrees F. Four die lubricants are available, the choice depending upon the shape of the parts and the intricacies of the channels through which the metal must be forced during injection. Die temperatures are held in the neighborhood of 400 degrees F., and are adjusted through the circulation of cooling water. The interval during which the die is kept closed after metal injection varies from a few seconds to one-half minute on larger parts. The injection plunger speed is controlled by adjusting the pressure in the plunger-actuating hydraulic system. Pressures of 800 to 2000 pounds per square inch are available, which give plunger speeds up to 1000 feet per minute.

The production cycle for each part is also standardized. The open die is first blown out with compressed air to remove any flash that may be left from the previous shot. A mist of light lubricating oil is next sprayed on the injection plunger. The die lubricant is then applied by spraying. With some parts, a single application of die lubricant is sufficient for several shots. In a few cases, cocoa butter is used as a die lubricant rather than other proprietary lubricants. The number of shots per hour varies between 15 and 200, depending upon the complexity of the part, the time that the die must remain closed, and whether or not loose die inserts are used, which must be removed from the part and replaced in the die before another shot is made.

Three electric furnaces of 800 pounds capacity each are used for initial ingot melting. One of these furnaces is illustrated in Fig. 2. The ingots are preheated prior to loading in the furnaces, so as to remove all traces of surface moisture and thus avoid metal spatter when they are loaded. The preheat temperatures are above the boiling point of water. The melting furnaces operate at 1250 degrees F., and are controlled by thermo-couple. The surface of the molten metal is kept covered with a film of No. 220 Dow magnesium flux to minimize oxidation.

Metal is transferred from the melting furnaces to the holding pots on each machine by means of transporter pots carried on fork lift-trucks, as seen in Fig. 3. The transporter pots

are kept heated to 1250 degrees F. by an electric heater element when not in use. They are not heated while in actual use, but the interval during which they are not employed is so short that a minimum of heat loss occurs. Immediately after the molten metal is poured from the furnace into the transporter pot, it is covered with Dow No. 181 agent to prevent oxidation. This is a combination sulphur and flux compound designed to affiliate with atmospheric oxygen before it reaches the underlying metal.

The transporter pot is emptied into the holding pot at the machine, as shown in the illustration, through a narrow spigot opening, so as to avoid contact with air as much as possible. The holding pots are kept covered at all times, and the space in the holding pot above the metal surface is kept filled with sulphur-dioxide gas admitted from a pressure cylinder. This gas prevents oxidation of the metal before it is ladled into the die-casting machine.

Prevention of oxidation of the molten metal is a necessary aspect of successful magnesium die-casting because, if not protected, the hot metal will combine readily with atmospheric oxygen and form oxides that are highly detrimental to casting quality. Each holding pot has a capacity

Fig. 1. Removing a magnesium die-casting from one of the open dies on a cold-chamber type of die-casting machine





Fig. 2. One of the three electric melting furnaces in the die-casting department, each of which has a capacity of 800 pounds

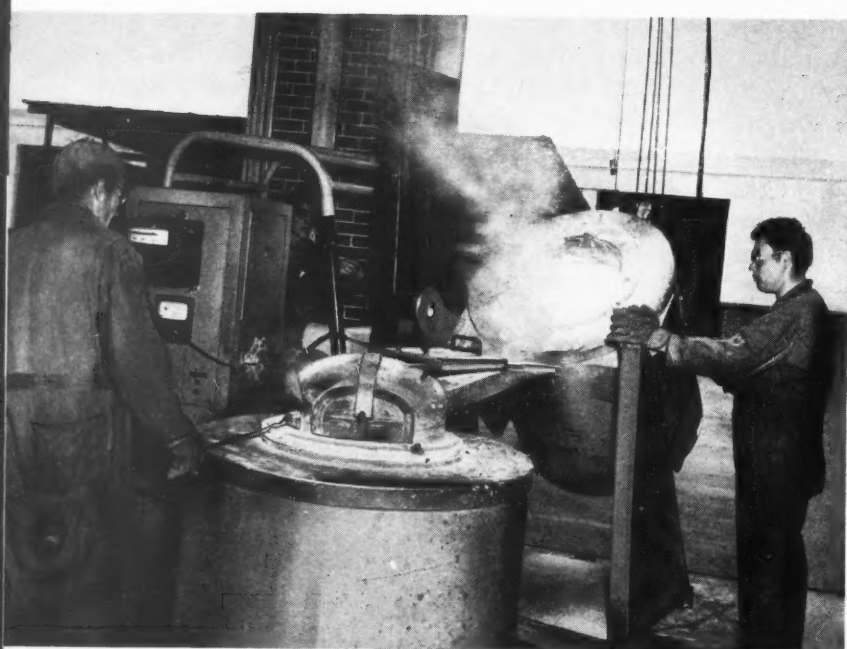


Fig. 3. Transferring molten magnesium from a transporter pot held on a lift-truck to a holding pot at one of the die-casting machines

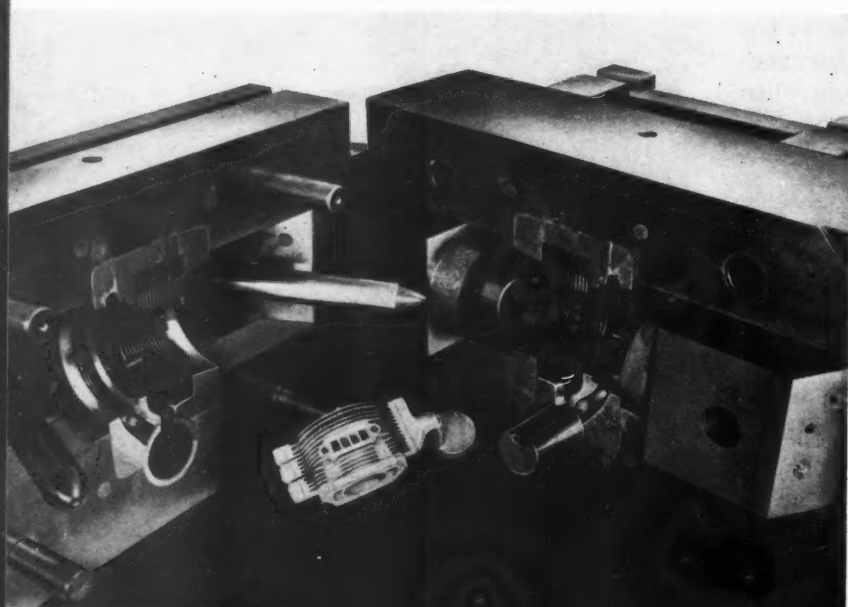


Fig. 4. Die-casting die of insert type used in casting one-piece cylinders and cylinder heads with cooling fins

Fig. 5. Toolmaker filing a replacement cooling fin insert for a cylinder and cylinder-head die-casting die such as shown in Fig. 4



of 300 pounds of magnesium, which is enough to last through several hours of die-casting.

Complicated dies are constructed in sections, so that if wear or breakage occurs, the section affected can be easily replaced. This eliminates the necessity of replacing an entire die, and keeps maintenance expenses at a minimum.

Conventional hot-worked die steel is used exclusively for all contact and coring surfaces of dies, and either a high-grade cast iron or mild steel for the die-blocks. Enough metal is provided in each die-block to prevent heat checks or warpage as well as distortion resulting from the heavy locking pressures used on the die-casting machines. Machined hot-worked die steel inserts are mounted on the die-blocks by means of conventional machine screws.

The die used for casting a one-piece cylinder

and cylinder head, complete with cooling fins, is provided with steel inserts in each half for forming the cooling fins, as can be seen in Fig. 4. In addition to providing an easy means of replacing the thin die sections, this construction facilitates machining the die, since the inserts are machined individually. In fact, it would be practically impossible to machine dies of this type in one piece. Multiple-cavity dies are used extensively, and are often designed for casting several different parts with one shot.

Die surfaces are given as much draft (taper) as possible to facilitate easy ejection of the part. The taper on contact surfaces of dies and on cores ranges from $1/2$ degree to 2 degrees, the larger amount of draft being used whenever possible. Cored holes as small as 0.060 inch in diameter have been found practical.



Fig. 6. Toolmaker engaged in assembling an insert into one of the halves of another typical die-casting die

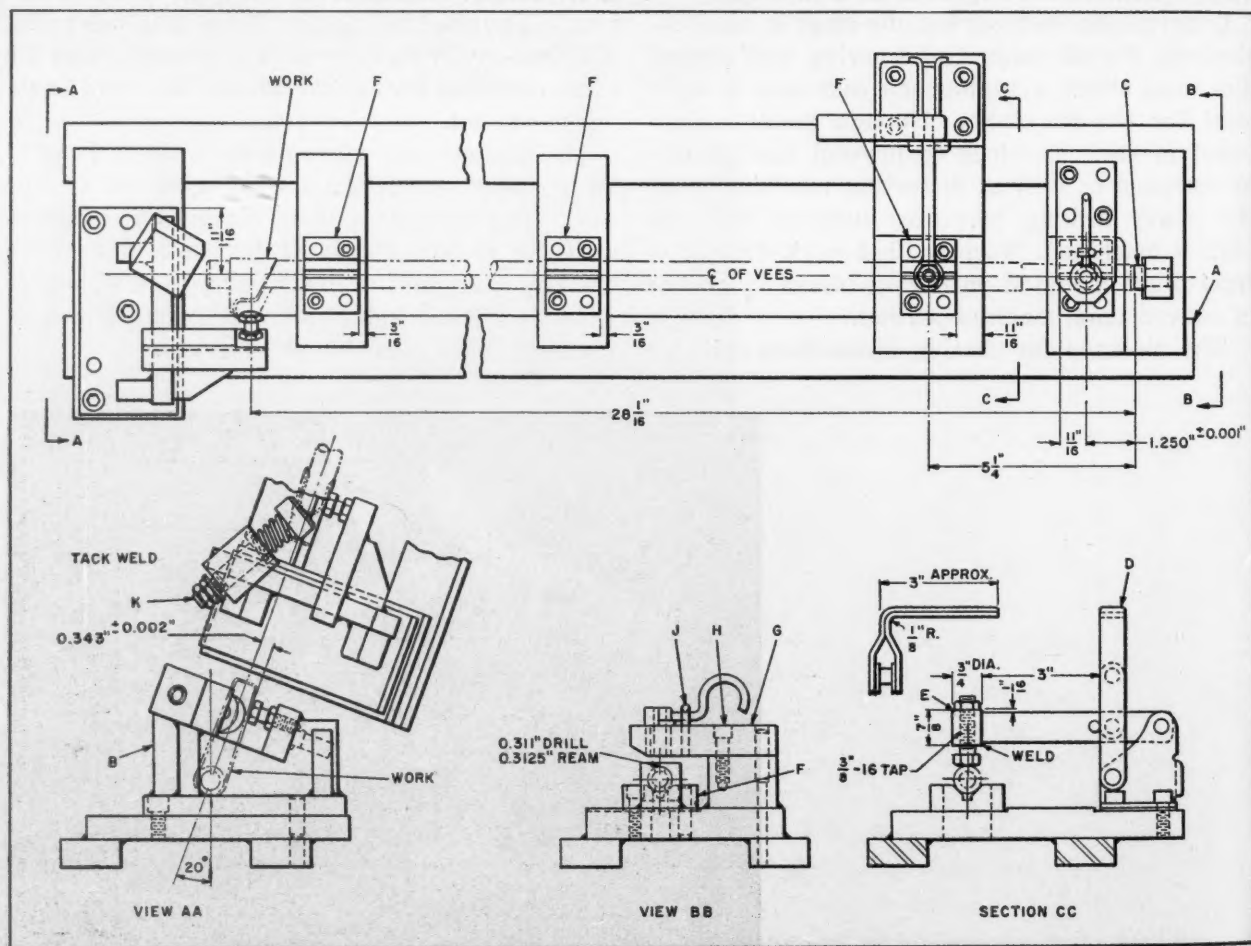
Welded Construction Simplifies Drilling and Reaming Fixture

By E. W. OBRINGER, Design Consultant
The Lincoln Electric Co.
Cleveland, Ohio

MANY plants are now using welded steel construction in making their jigs and fixtures. The Studebaker Corporation, South Bend, Ind., for example, employs this type of construction to great advantage in a large number of special tools and equipment, even though the company has both a well equipped pattern shop and a modern foundry. The illustration shows a fixture designed for drilling and reaming a transmission remote-control shaft assembly used in Studebaker cars. The operation consists of drilling a hole 0.311 inch in diameter and then reaming it to 0.3125 inch.

In constructing the fixture, machine steel sections are welded together to form the base *A*, the surfaces that require to be finished are machined, and the various holes indicated are drilled and tapped. A work locating block *B* is also made of machine steel sections, welded together as shown. After being welded, the surfaces of the block are machined and the necessary holes are drilled, reamed, or tapped. The block is then fastened to the fixture base with dowels and socket-head cap-screws.

A hardened and ground tool-steel pin *C*, which is a drive fit in the base, locates the work at the



Drilling and reaming fixture of welded construction for a large irregular-shaped part

other end of the fixture. The work-piece is held by a toggle clamp *D*. It will be noticed that welding has again been used to add a boss *E* to this clamp. Four hardened V-blocks *F* are fastened on the base in alignment with the toggle clamp to hold the work. The block at the right is similar to the others except that a clearance hole is provided in the center for the reamer.

Above this block, on the welded projection, is a cold-rolled steel plate *G* containing a hardened and ground liner bushing. The bushings to guide the 0.311-inch drill and the 0.3125-inch reamer are inserted in the liner bushing and a hook-shaped handle, for convenience in inserting and removing them from the fixture, is welded to each one. An angular pin *J*, driven into the bushing plate, contacts the handle and holds the bushing during the machining operations.

A work-piece positioning pin *K* in block *B* has a tension spring between the head and body. On the threaded portion of the positioning pin is placed a steel washer and two hexagon nuts. The work-piece is forced back by the head of the pin against an adjustable steel hexagon-head cap-screw, which is fastened with a steel hexagon nut, thus locating the work in the machining position, ready for clamping.

In operation, the fixture is placed on the table of a drill press and the toggle clamp is moved back to permit loading. One of the assemblies to be machined is then placed in the V-blocks *F*, and the positioning pin *K*, acting through the spring, forces it in contact with pin *C*. The toggle clamp *D* is next swiveled into position to clamp the work securely in place. To remove the work-piece after drilling and reaming, it is only necessary to swivel the toggle clamp out of the way.

This fixture, which positively locates the work and holds it securely, is a good example of the possibilities of using welded construction in cases where large and irregular-shaped parts are to be held for machining.

* * *

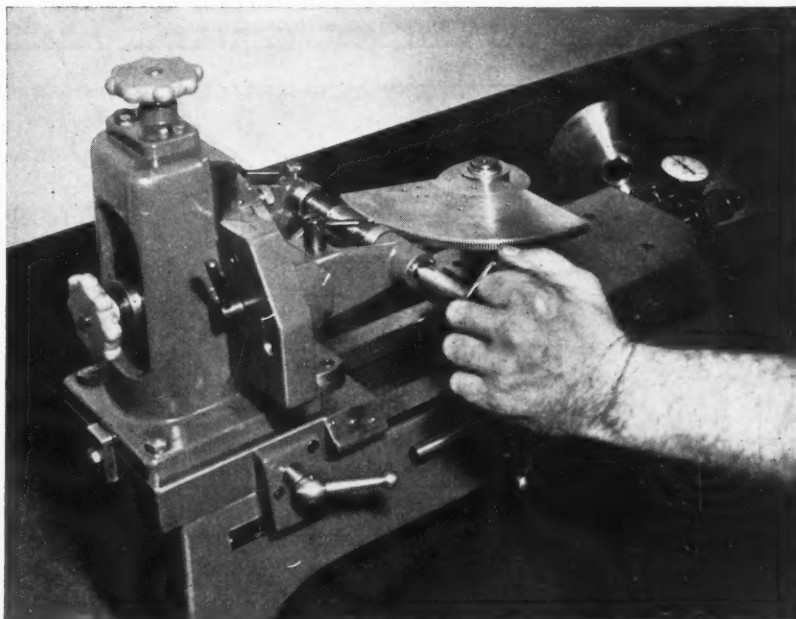
Film on Optical Gaging

A 16-millimeter sound motion picture entitled "Optical Gaging," which demonstrates the principles of optical gaging, has been produced by the Eastman Kodak Co., Rochester, N. Y. It also shows how optical gaging is being used in modern mass production and inspection, and presents a comparison of a part inspected by both mechanical and optical gaging. The film is available on loan to industrial, educational, and professional groups through Engineer Specialties, 980 Ellicott St., Buffalo, N. Y.

* * *

Lapping and Checking Gear Sectors on the Same Machine

Brass gear sectors having teeth of 36 diametral pitch and a pitch radius of 5 inches are assembled into a crystal analysis unit built by the North American Philips Co., Inc., New York City. The tooth spacing must be accurate within 0.0002 inch. The gear teeth are lapped by swiveling the sector back and forth in mesh with a worm, which is backed up by a coil spring on the same shaft, so that only one side of the sector teeth is engaged. A dial indicator on the equipment indicates the amount of backlash.



Checking a gear sector on a machine that is also employed for lapping the teeth

Unique Designs of Progressive Press Tools

By R. KIRCHNER, Director and General Manager
and G. V. BEVAN, Development Engineer
Arnott & Harrison, Ltd., London, England

THE two-station progressive die shown in Fig. 1 was designed to produce two of the mild steel brackets seen in Fig. 2 at each stroke of the press. The parts are made from strip stock 1 3/4 inches wide by 0.048 inch thick. At the first station, four small bosses are formed, two on each part. When the strip is initially fed between the lipped guides A, it is positioned to overhang the cutting edge B of the die. Then when the press is tripped, the bosses are formed and the strip is cut to correct length by the cutting edge of punch C. The small piece of scrap falls away through the bolster.

The boss-forming punches at the first station are fixed in the lower die member and are backed

up by a steel plate. The mating hardened steel boss-forming dies in the upper die member are mounted in a pad which clears the guides and closes solidly when the tool is shut.

At the next station, the material is severed by the punch C, and, after being separated by the punch D, the forming of the two components is completed, and the parts fall from the tool, which is used in an inclinable press. Ejection is assisted by an air jet, which is operated from the press ram. Small spring-loaded pusher-pins are fitted in both the top and bottom die members to break any oil seal that may be formed. Before the severing operation, a local pressure-pad E grips the stock in order to prevent bowing.

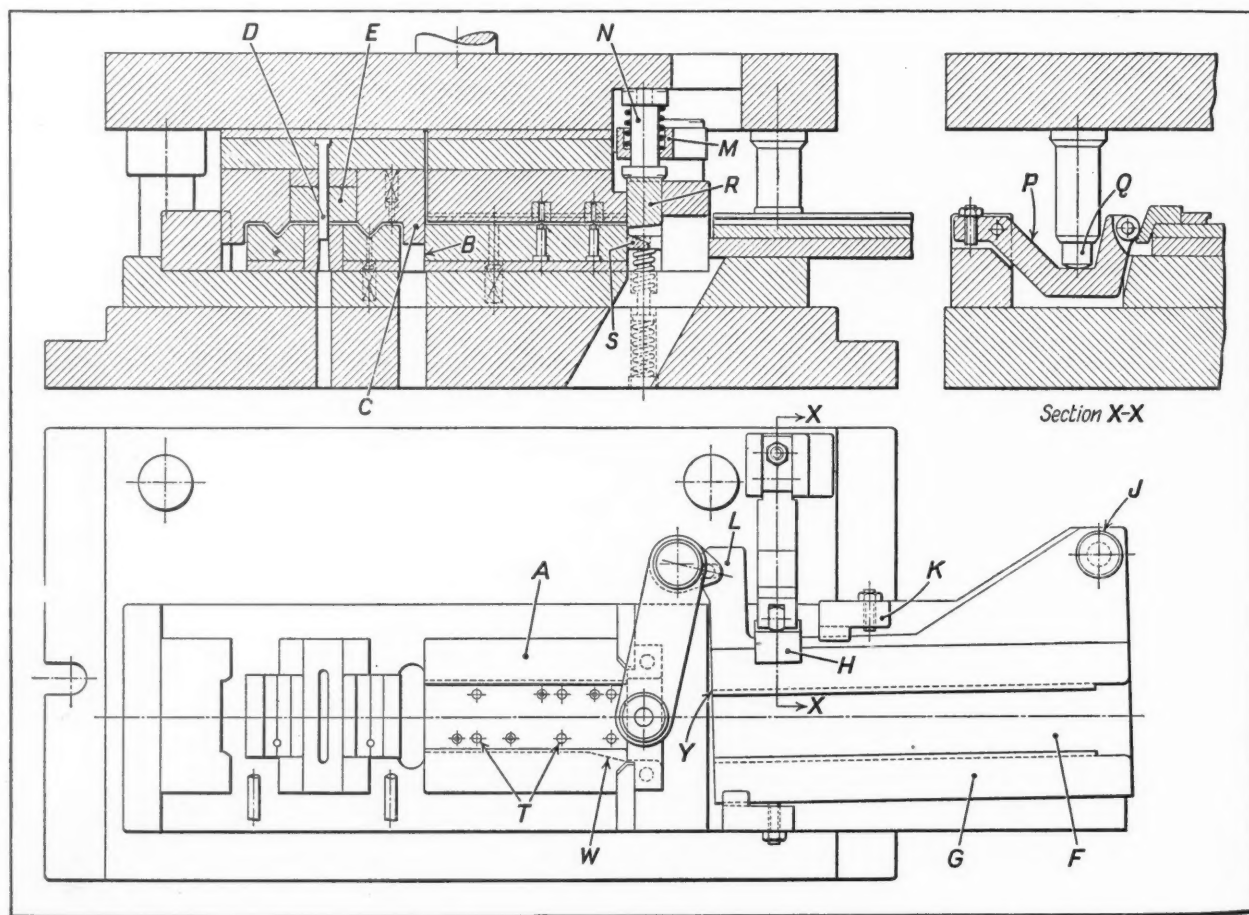


Fig. 1. Two-station progressive die that produces two of the mild steel brackets seen in Fig. 2 at each stroke of the press

When parts are formed from coil material, little attention need be paid to the relatively small amount of scrap left at the end of the coil. However, in cases where short strips are used for long production runs, the percentage of waste from progressive dies is considerably increased, and if this factor is disregarded, it may completely outweigh the advantages of using such tools. To overcome the problem in this instance, a guillotine cutter is incorporated, which automatically severs the surplus material from the end of each strip, so that the last component is not scrapped.

Mounted on the die bolster is an extension plate carrying a front guide assembly comprising a rest plate *F*, with lipped side guides *G*, and a cam-block *H*. The assembly is arranged to pivot about the shouldered pin *J*, and is further retained by the blocks *K*, each of which is fitted with an adjustable stop-screw to limit the travel.

Integral with the rest plate is an extension arm *L*, which is slotted to engage a pin fixed in the lower part of the swivel-arm *M*. The swivel-arm, in turn, carries a spring-loaded hammer *N*. The guide assembly is moved about the pivot by a rocker arm *P*, seen in section *X-X*, which carries a roller engaging the hardened cam-block *H*. The arm *P* is operated by a spring-loaded plunger *Q*.

When a strip of material is loaded through the front swivel guide assembly and into the fixed guides *A*, it positions and holds the swivel assembly in line. No movement takes place, as the spring plunger contacts the rocker arm when the press is in action, the plunger merely being compressed. This condition prevails until the end of the strip recedes into the front guides and cannot be handled further. Another piece of material is then fed into the die and used to advance the preceding strip.

After the end of the first piece has passed the point *Y*, thereby freeing the swivel guide, the next downward stroke of the press ram causes the assembly to move approximately 1/4 inch at this point through the medium of the spring plunger and rocker arm. This, in turn, swivels the arm that carries the spring-loaded hammer and positions the latter directly over the guillotine cutter *R*.

Toward the bottom of the stroke, the top bolster makes contact with the hammer, thus causing cutter *R* to cut the material to the correct length. The following piece of stock is then moved forward into contact with the strip already in the die, and, due to the angular lead at *W*, enters the fixed guides without obstruction and lines up the swivel guide assembly again. A spring-loaded ramp is provided at *S* which,

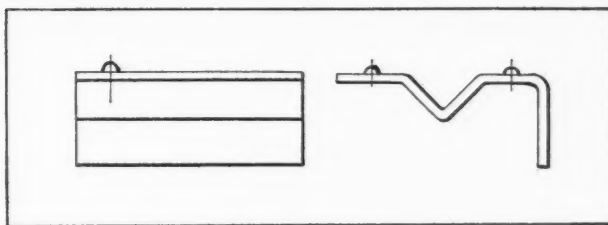


Fig. 2. Mild steel bracket made, two at a time, from strip stock 1 3/4 inches wide by 0.048 inch thick on the progressive die seen in Fig. 1

together with the spring pins *T* contained in the die, holds the material against the under side of the guides *A*, so that it clears the protruding punches as the stock is fed.

Twelve-Station Die for Forming Tubular Parts

An example of an economical method of producing tubular parts is provided by the twelve-station die shown in Fig. 3. In this case, the work consists of a lead-holder used in a mechanical pencil. This part, shown at *X*, has a bore of 0.046 inch, and is made from brass 0.008 inch thick, the joint being butted. Opposite the joint, and located 1/8 inch from one end, is a small boss, the purpose of which is to engage the pencil scroll. The extreme outside diameter of the boss is 0.036 inch, and it is flattened on two sides in line with the axis to a dimension of 0.025 inch, the total height of the boss being 0.040 inch. All these dimensions are held to ± 0.002 inch.

Instead of the more orthodox method of producing the part from wide material, it was decided to employ 3/8-inch brass stock, and design a tool to form the component lengthwise. The material was automatically advanced by a single-roll feed, and although the part is relatively small, this method proved entirely satisfactory. While the dimensions of the drawn boss may seem very small, it was found by calculation, and proved by development, that five separate drawing operations were necessary to produce it.

These operations are carried out at the first five stations of the die. Also, at the first station, two semicircular cut-outs are notched in the strip at *A*, which are engaged by pilots in the following stations for positioning. The five drawing punches are independently adjustable for height, and at each station, with the exception of the first one, where the draw is very shallow, small spring ejectors are fitted in the bottom die member to return the drawn part to die level in order to facilitate feeding.

To hold the stock while drawing, pressure is applied by the spring pad *B*. This pad covers

the first half of the die, including the sixth station, where the boss is flattened to a width of 0.025 inch by two slides *C*. These are actuated by the spring-loaded cam *D*, and when closed they abut against a stop-pin *E*, leaving the correct gap at the top.

In forming the boss, it was found that no appreciable drag took place lengthwise, and consequently the length of the part remained constant. However, as anticipated, the strip width was reduced in the locality of the draw. The 3/8 inch width of the strip provides for some deformation, and, in the next station, the surplus is removed from each side by two cropping punches *F*. This operation cuts the metal to the correct width in preparation for curling.

Hardened stop-plates are provided in the fixed stripper at this station, and the material is fed up to them by the roll feed. The strip is actually over-fed by approximately 0.005 inch, and the pilots finally position it before any operation is performed. Two rectangular notches cut in the stock by punch *G* leave a narrow connecting strip

between adjoining work-pieces to insure progression through the remaining stations for the completion of the curling operations.

The die members at the side cropping and notching stations comprise five separate hardened inserts which are so positioned as to give the correct cutting clearances for the material. Machined in the center section is a slot which locates the boss and guides the strip into the following stations, where it is partially curled on the extreme sides by the spring-loaded punch *H*.

The bottom tool at this station consists of two separate forming dies with a spring pressure and ejector pad between them, by means of which a U-bend is formed. A slot is provided in the center of the pressure-pad to accommodate the boss. While the ribbon material droops slightly at this point, the amount is so small as to be negligible. In the eleventh station, the part is finish-curved by two slides operated by a spring-loaded cam in exactly the same manner as previously described.

Finally, after passing through a guide block, the components are parted from the strip by re-

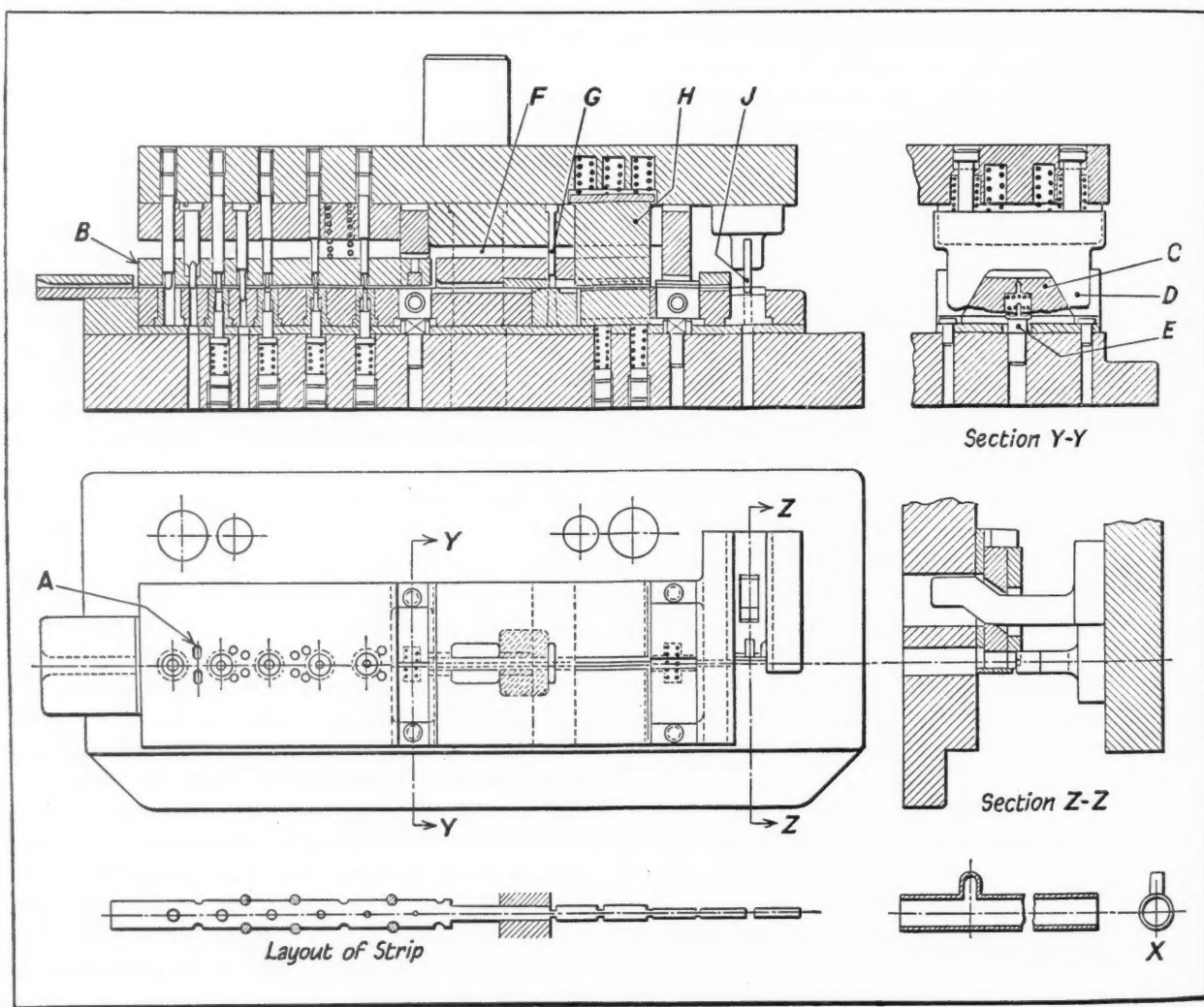


Fig. 3. Design of twelve-station die used in forming tubular lead-holders for mechanical pencils from 3/8-inch brass ribbon stock

removal of the connecting strips. This operation is illustrated in section Z-Z. The punch *J* is provided with two legs in advance of the cutting edge, whereby it is located and guided in the gap before the component is severed. The die is mounted on a slide which is actuated by the cam leg attached to the upper tool. When the component is fed forward, before it is parted from the strip, the die is retracted in order to clear the boss, which is on the under side.

Two bumper stops are fitted on the bolster adjacent to the guide pillars. To obviate the necessity for fine adjustment and precision setting at all stations, springs are used to apply the necessary load for flattening the boss and for the following forming operations. Also, all cutting punches are allowed to enter the die to a slightly greater depth than would normally be necessary, so that the only fine setting required is for the drawing punches. The relative thinness of stock, and the nature of the various functions, permitted this approach as an alternative to fixed cams, with considerable saving in die cost.

Progressive Dies for Thin Material

There are many factors that influence the choice of a progressive die, the most important being the total quantity of parts to be produced. In some instances, however, the size of the product may be of equal significance. When the parts are very small, handling and loading on single-operation dies becomes exceedingly difficult and slow, and at the same time, the chances of accident are considerably increased. Also, owing to the many separate locations required, which must invariably provide an easy fit, accuracy must sometimes be sacrificed.

In a radio tube, for example, there are many small and intricate parts made from nickel 0.002 to 0.006 inch thick. The fine limits of accuracy required and the objectionable features of single-operation tools previously mentioned have led to the successful adoption of the progressive die method for producing such parts.

Apart from the very close tolerances to which the components are held, it is also essential that

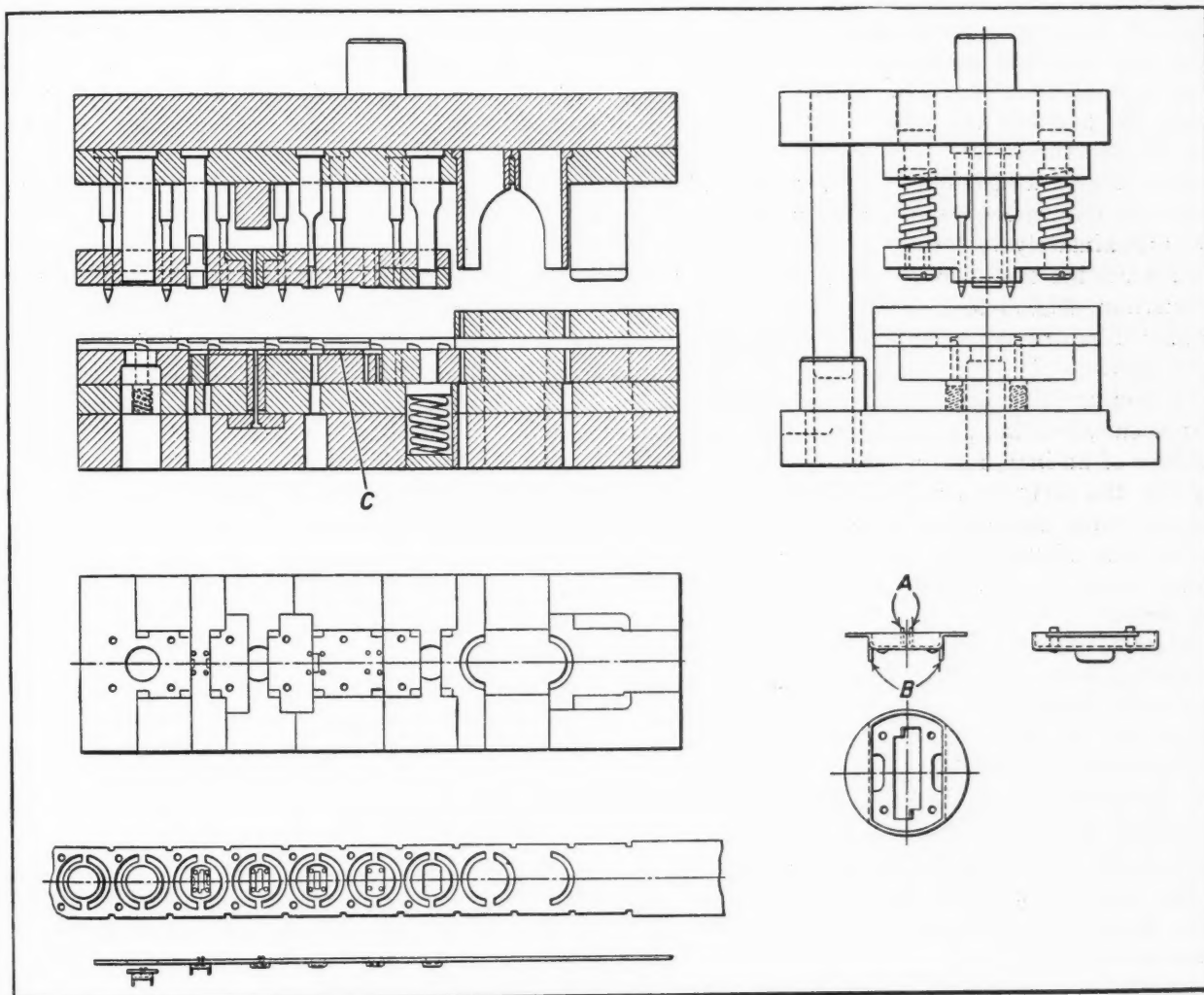


Fig. 4. Nine-station progressive die for producing a radio-tube screen from 0.006-inch thick nickel at the rate of 8000 per hour

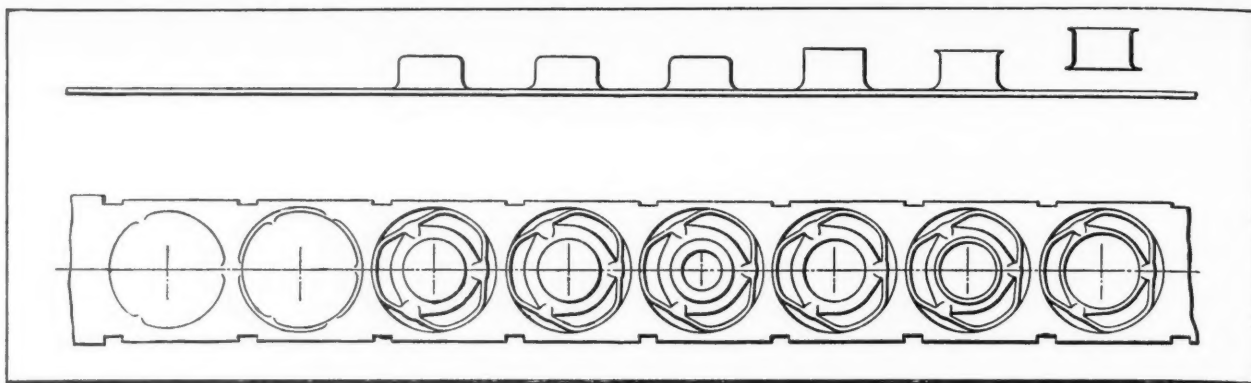


Fig. 5. Lay-out of the strip produced in forming flared tubes on an eight-station progressive die of the design illustrated in Fig. 6

they be free from burrs, and for this reason, the punches and dies are ground and sometimes lapped on all cutting faces. This necessitates the die being split and built up in several sections, and, in order that these sections may be fairly rugged, the completed tool is sometimes made larger than would seem necessary, one or two idle stages being included. However, this slight disadvantage can be discounted. The cutting edges of the dies are left with a slight parallel land, and are then backed off to an angle equivalent to 0.002 inch per inch. To avoid burr formation, the punches are made on easy push fit in the die apertures.

In order to assist slug clearance and at the same time increase the runs between regrinds by approximately 30 per cent, soluble oil is freely used while the tools are in operation. With this precaution, 90,000 to 100,000 parts are usually produced before any maintenance work becomes necessary.

In feeding thin stock through progressive dies, displacement of the pilot-pin by a few ten-thousandths of an inch, for example, may deform the part of the strip in which it locates. For this reason, extra material is invariably provided in order that all pilot-pins may be located in the scrap, thereby preventing deformation of the component.

A multi-station tool of this type is automatically fed with strip by a mechanical roll feed, and much greater success has been achieved by fitting this at the outgoing end of the tool, so that the material is pulled instead of pushed forward, any tendency to buckle being thus eliminated. Double-knife choppers are also incorporated in these tools to assist feeding, and, as both sides of the material are cut, better control of cross-wise location is obtained in the following stations of the die.

An example of a nine-station progressive die for a thin component is shown in Fig. 4. The part (seen at the lower right) is a radio-tube

screen made of nickel 0.006 inch thick. All dimensions are held to limits of ± 0.002 inch. A sectional and an end view of the tool are shown in the illustration, together with a die and strip lay-out. After a side chopping operation at the first station, the strip is pierced with crescent-shaped punches at the following two stations to allow the material to be drawn.

The drawing operation is performed at the fourth station with a spring pressure-pad which is attached to the top die member and acts as a blank-holder. Up to this point, a fixed stripper is employed, but beyond, a spring-loaded stripper is provided.

At the next operation, dimples are formed in the base. For this purpose, four small needle punches are fitted to the spring stripper, the pressure exerted by the springs being sufficient for the operation. Next, a rectangular slot is pierced, and, at the seventh station, the lugs A are sheared and formed upward.

For this purpose, two slender punches are mounted in a holder which, in turn, is held in the lower die member. The top die insert is carried in the spring stripper. The remaining lugs B are sheared and formed downward at the following station, and finally the part is blanked from the strip. In order to free each blank and avoid possible damage due to packing, the die is relieved up to within 1/4 inch of the face, and the blanking punch, when down, protrudes into the clearance space, so that each component is fully ejected.

Another method of parting the finished component from the strip which is frequently used when working on thin stock is to shear the material around half of the periphery in one station and complete the operation at the next and final station. When this procedure is adopted and the die aperture is enlarged around the portion that has previously been sheared, the blanks readily fall away.

In performing a drawing operation, a slight

radius inevitably results at both ends of the cup, but in this instance, such radii are reduced to a minimum by coining at the seventh station, when the lugs *A* are produced. The plate *C* is hardened, and at this station, there is an accurately shaped hole with a radius on the top edge of approximately 0.005 inch, which is used as the coining die.

For further control of the length of the part, two pilot-holes are pierced at the fourth station, and at each successive station, pilot-pins enter these holes to locate the material positively. Each pilot has a long conical lead to eliminate distortion due to possible feeding errors. Lipped members are fitted to the die to guide the strip while it is being fed.

Referring to the die lay-out, several small rectangular apertures will be seen. These contain spring lifting pins, and after each operation, the material is raised sufficiently to permit the drawn part, together with the lower lugs, to clear the die face while passing on to the next station.

When this component was initially designed, it was uncertain whether it would be adopted in the final assembly, and, in consequence, four separate single-operation dies were made for its production. It is of interest to note that the production rate with these dies was approximately 400 per hour. Using progressive dies and automatic feed, the rate was increased to 8000 per hour.

The sequence of operations for a drawn and flared tube shown by the strip lay-out, Fig. 5, is of particular interest. In this case, the strip is cut in a special manner, so as to permit the material to flow easily during drawing. When the cup is drawn, the flange of the blank decreases in diameter and the three bands connecting the blank to the strip are pulled in and deformed, as shown. With this method, the results of any errors in calculating the length of stock fed are reduced to a minimum. It is believed that even deeper cups could be drawn progressively in this way.

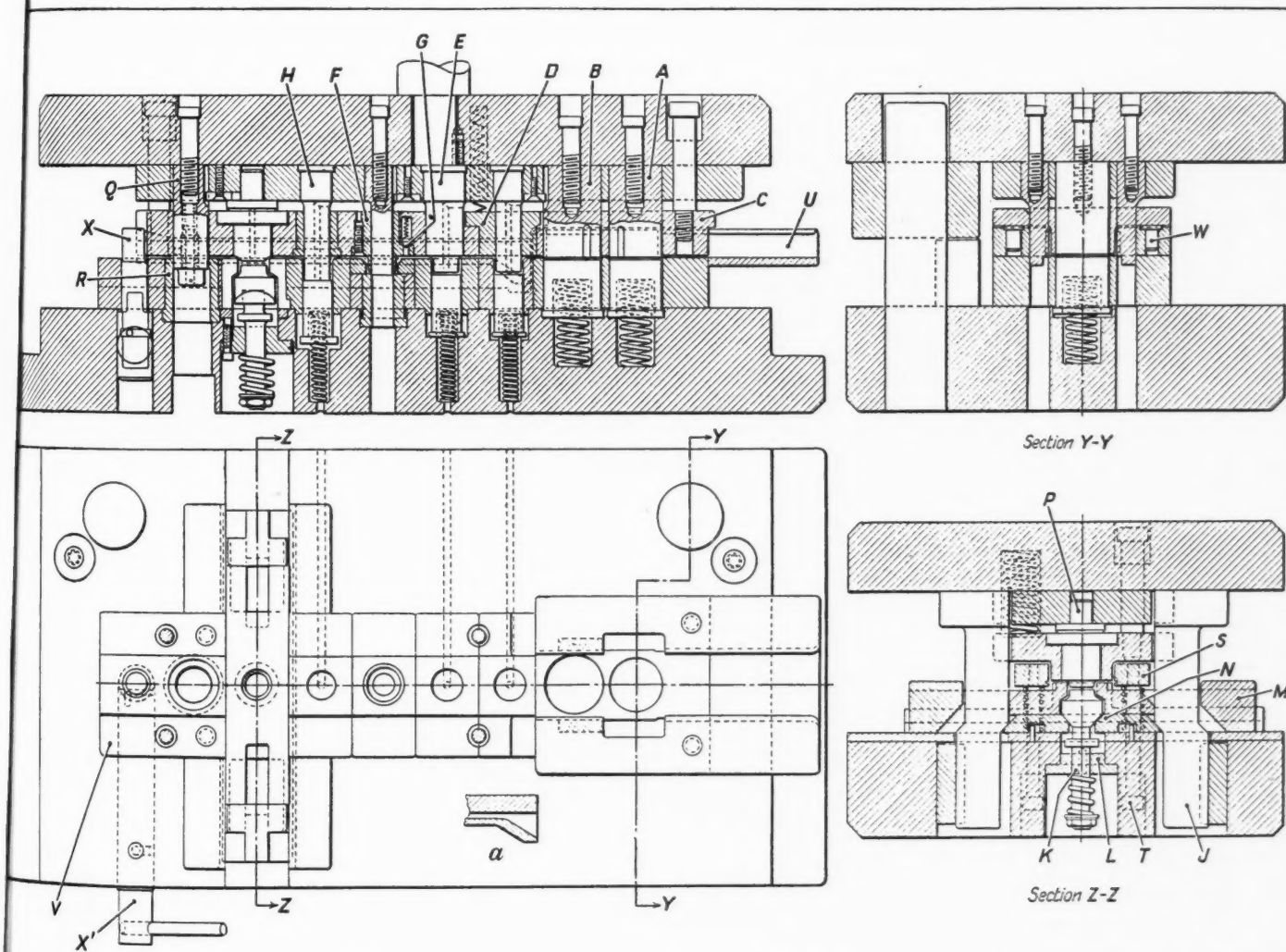


Fig. 6. Progressive die employed for drawing and flaring tubes in the sequence shown in Fig. 5. The stock strip must be especially cut to permit drawing.

Progressive Die for Flared Tubes

The eight-station die on which these tubes are produced is illustrated in Fig. 6. At the first station, the blank is partially cut by the punch *A*, which has three small, equally spaced, semicircular notches machined in the periphery at the working end. The purpose of these notches is to remove portions of the cutting edges in order to leave the blank connected to the strip. The ejector pad in the bottom die member returns the partially cut blank to the die face.

At the next station, the strip is cut in a similar manner, but the punch *B* used here is 1/8 inch larger in diameter, leaving connecting bands 1/16 inch wide. These three notches are so positioned relative to the first three as to produce the condition shown on the strip lay-out. At the first station, side choppers are incorporated to control the feed and improve the strip location.

A large spring stripper *C* is employed to strip the metal from the various punches. Carried in this stripper at the third station is a spring-actuated ring *D*, which acts as a blank-holder for the drawing operation. Next, the diameter of the cup is enlarged 0.002 inch, and the top and bottom radii are reduced in size by the coining punch *E*.

In the following operation, a hole is pierced in the base, a bushing *F* being attached to the main stripper and extending down to strip the metal from the punch adjacent to the hole. The extended portion is machined with a slight taper, so that it locates the cup at the top, prior to piercing. Three small spring pins *G* are provided to release the cup from the bushing should this be necessary. The body of the cup is then ironed to a parallel form by the punch *H*. During this operation, the diameter is again increased 0.002 inch, bringing it to the final size, before the strip is progressed to the next station, where the flaring operation is carried out.

Referring to section *Z-Z* of the die, four slides, actuated by the cams *J*, are employed to perform the flaring operation. These cams are equally spaced about a spring-loaded mandrel *K*. The mandrel has an integral collar, and when the tool is open, the mandrel is pulled down by its spring and the collar makes contact with the guide bushing *L*. The top or pilot end of the mandrel is so positioned as to permit the ironed cup to locate over it.

As the upper die member descends, the main slides *M* are moved inward by the cams. These slides are arranged to completely enclose the outside diameter of the cup when they are together. Upon further movement of the cams, the angular faces contact the secondary slides *N*,

and these are pushed inward, forcing the mandrel upward in order to complete the flaring operation. The spring loading of the stripper is sufficient to counteract this force. In order to limit the flaring, a positive stop *P* comes into action at the bottom of the stroke.

At the final station, the finished piece is parted from the strip by the blanking punch *Q*. The latter enters the die insert *R* approximately 1/4 inch, and below this point the die is relieved. In order to positively eject the piece through the die and bolster—to obviate possible jamming or packing—a spring-loaded pilot is fitted to the punch. The finished tubes are directed through the slot on the under side of the bolster by an air jet, controlled by the press ram.

Since the material is drawn down in the manner described, the strip must be raised a considerable amount in order to feed the cups over the die face. For this purpose, two spring-loaded guide rails are incorporated in the die, as indicated at *S* in section *Z-Z*. These rails are slotted on the inside to receive the flat part of the strip, and are spring-loaded to move in an upward direction. They are positioned and retained by four shouldered screws *T*.

There is a lead-in at the feed end, as shown by the view at *a*, to allow a new strip to ride up into the slot. The partially formed components are held clear of the various die openings, and as the tool closes, the stripper contacts the guide rails and depresses them, together with the strip, thus pushing the cups into the die.

It will be seen that at the last five stations, the cups enter the die freely and are therefore approximately positioned. The final location is controlled by the four top punches and the slides *M* at the seventh station. The stationary lipped guides *U* at the front are of a sufficient height to cover the vertical movement of the strip.

Fitted to these guides and to the die-block *V* are four leveling pins *W*. When the tool is closed, the heads of these pins clear the under side of the stripper by 0.005 inch. The purpose of the pins is to keep the stripper level under two conditions—namely, when a new piece of material is in the first few stations, and when the trailing end of the strip is passing through the die.

A location pin is provided at *X*, in the lower end of which a cross-slot is machined, the pin being raised and lowered by the eccentric *X'*. The purpose of this pin is to allow 6-foot lengths of material, as well as coil, to be used. When a new strip is introduced, the pin is lowered and the feed of the first 4 or 5 feet is controlled by the side choppers. The pin is then raised and the remainder of the strip is fed up to it, the amount of scrap being thus reduced.

Brazing the Modern Way

By LESTER F. SPENCER

THE previous installment of this article, published in April MACHINERY, described heating mediums for different brazing methods, as well as the brazing alloys and fluxes to be used. The present installment will cover methods of brazing various materials.

The low-carbon steels are frequently copper-brazed in a controlled-atmosphere furnace. However, salt-bath, induction, and torch-brazing methods are also employed for steels of this composition, using a silver-base brazing alloy. In copper brazing, the high temperature required (2050 degrees F.) produces some grain growth within the base metal. Where this is a detriment to the finished product, the condition can be corrected by heat-treatment without affecting the brazed joint. Silver brazing is employed to a considerable extent for joining low-carbon steels in salt baths. Brass, bronze, and copper brazing alloys are also used successfully.

One prerequisite of salt-bath brazing is that the assembly be designed to permit adequate drainage of the salt after brazing. An advantage of this method of brazing is that localized heating can be obtained by simply immersing the work in the salt bath to the depth required. However, complete immersion in salt is the usual practice. Both torch and induction brazing can be classified as localized brazing methods.

Generally, the medium- and high-carbon steels are also furnace-brazed, using either brass or copper as the brazing material. In order to prevent decarburization in the base metal, a high-carbon potential atmosphere with a dew point of minus 40 degrees F. is required. Because these steels normally have to be heat-treated to obtain the desired mechanical properties, copper brazing is usually recommended.

In the salt-bath brazing of these metals, a silver brazing alloy can be selected whose melting point is slightly higher than the transformation point of the base material. Hardening is obtained by quenching the assembly directly after the brazing operation. Alloys containing phosphorus are not recommended for brazing materials because the resultant iron phosphide will cause embrittlement.

Silver brazing alloys of low melting point are preferred in joining such alloys as nickel, Inconel, and Monel metal. This is particularly true with Monel metal, which is subject to intergranular attacks by molten brazing alloys above 1400

degrees F. The preferred brazing compositions are those that melt below 1200 degrees F. In special cases, brazing alloys with a high silver content are used to advantage in assemblies subject to attack by caustic solutions. As with medium- and high-carbon steels, phosphorus brazing alloys are not recommended for these materials.

High-nickel alloys can be brazed by torch, electric-furnace, incandescent-carbon, electric-induction, or salt-bath methods. In torch brazing, a neutral or slightly reducing flame is employed. Where it is desirable to restrict the area to be wetted by the brazing alloy, a thick stop-off paste consisting of graphite and sodium silicate can be applied effectively. This paste is easily removed after brazing.

The high-nickel alloys are susceptible to sulphur embrittlement, and suitable precautions must be taken to remove traces of this harmful element in both furnace and salt-bath brazing.

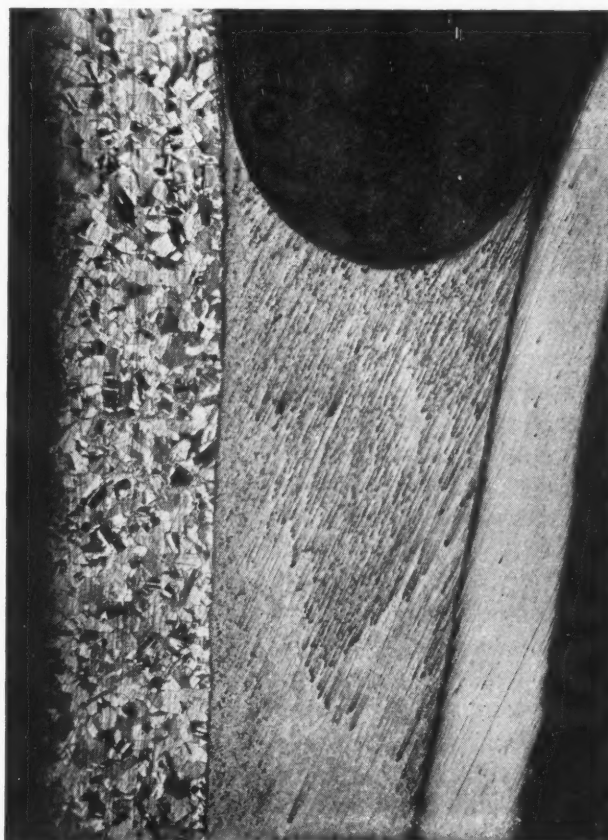


Fig. 2. Photomicrograph of a successful brazed joint between Type 302 stainless steel and 10 per cent nickel-silver, accomplished by the torch method

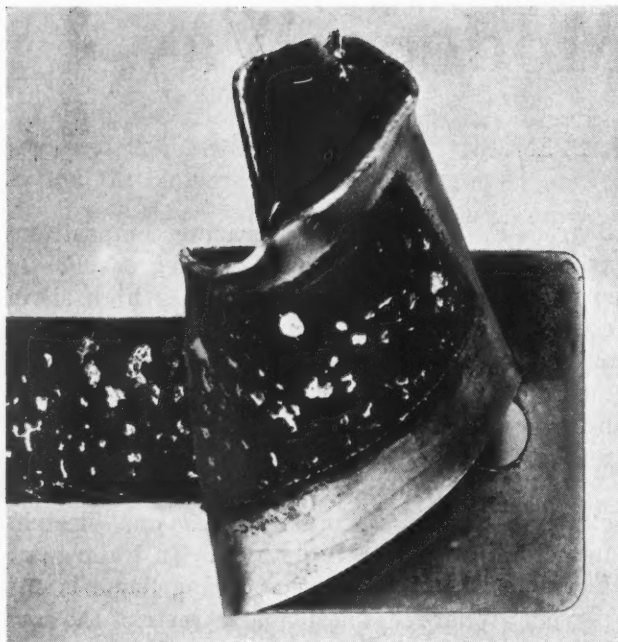


Fig. 3. Tear test of Kolene-treated cast iron brazed to a steel strip shows that breakage occurs in the parent metal rather than at the joint

When high-temperature salts are used for brazing, small amounts of sulphur can be removed from the bath by suspending scrap sheets of nickel alloy or nickel turnings in the bath for a period of two hours at the brazing temperature to be employed.

Since the temperatures required for brazing are well below the annealing temperature of these metals, the softening effect is very slight. Heat-treated K Monel or Z nickel can be silver-brazed with only a slight local softening. Age hardening heat-treatment can also be performed on these two nickel alloys after silver brazing is completed. Lap joints are preferred to butt joints, since better alignment can be obtained between two members. In lap joints, the preferred clearance is between 0.002 and 0.003 inch, although in some instances, the clearance may be as high as 0.005 inch.

The austenitic stainless steels are quite easily brazed, silver brazing material usually being employed. Within the austenitic group, the most difficult is the 303 type, usually identified as the "free machining" grade. The straight chromium stainless steels (400 series) are more difficult to silver-braze, probably due to the type of oxide formation that takes place during brazing.

In brazing the austenitic stainless steels, heating is, unfortunately, within the carbide precipitation range, and care must be taken to complete a braze within the shortest time possible, so that the corrosion resistance of the material will not be affected. In some instances, low-carbon stainless steels, such as Type 304, where the maximum

carbon content is 0.08 per cent, are used in brazed assemblies, since the low carbon content minimizes the precipitation of intergranular carbide. If the design permits, assemblies are quenched directly after brazing, this practice usually being performed on torch-brazed assemblies.

Where the factor of corrosion is of extreme importance, the stabilized grades of stainless steel may be used. Unfortunately, there can be no corrective treatment for redissolving precipitated carbides within a brazed assembly, since the temperature of the necessary annealing procedure is far above the melting temperature of the brazing alloy.

A successful braze between two dissimilar metals, such as 10 per cent nickel-silver and Type 302 stainless steel, is illustrated in the photomicrograph Fig. 2. The silver brazing alloy used in this case was "Easy-Flo," and the method of joining was by torch. The hardenable or martensitic types of stainless steel are brazed at a temperature below their critical point (usually below 1500 degrees F.), in order to avoid air-hardening. Within the ferritic group, brazing temperatures are also limited to prevent the possibility of grain growth.

Bright surfaces can be produced in furnace-brazing stainless steels by using an atmosphere of pure dry hydrogen or dissociated ammonia. Although this practice is rather costly, the expense is justified on difficult assemblies. Induction heating is also used with success, this method providing a rapid localized heat within the proposed joint.

The incandescent-carbon method of heating is advantageous where the work lends itself to this type of heating. In this method, a thin sheet of brazing alloy is inserted between the surfaces to be joined after they have been properly cleaned; then the assembly is set up in the brazing machine and electrically heated through carbon blocks, which form the jaws of this equipment. The parts are heated rapidly and evenly, a minimum of flux being required, since the speed of operation and the type of heating reduce the formation of oxide.

Cast iron can be brazed by torch, induction, or furnace heating methods. In general, cast iron is not easily wetted by high melting temperature alloys, such as copper, in controlled-atmosphere furnaces because of the formation of silicon oxides and the high concentration of carbon within the metal. Silicon oxides are formed by impurities in the furnace atmosphere, and they are not reduced by hydrogen. Thus, it is usually necessary to keep the carbon concentration in cast iron and the formation of silicon oxides at a minimum to braze successfully, as the control of these two conditions will provide

satisfactory wetting when brazing with copper.

The same reaction is true when such brazing materials as brass or silver solder are employed. However, the oxidizing effect at the lower brazing temperatures used with these alloys is not as great. Wetting properties can be influenced by the use of a flux. Another method used on some grades of cast iron is to first oxidize and then reduce the surface of the parts in furnaces previous to assembling them for brazing. In some instances, the addition of nickel in the base composition is of help because of the affinity of nickel and copper.

The "Kolene" process is being used with considerable success as a preparatory cleaning procedure for cast iron. This process consists of electrolytic oxidation reduction cycles. The procedure followed is to immerse a casting in molten "Kolene" No. 4, the operating range of which is from 850 to 950 degrees F. In the first phase of the cycle, the work is negative, and the resulting reduction removes sand, scale, and other surface oxides. With the castings remaining in the bath, the current is reversed, and the oxidation thus produced removes graphite, combined carbon, sand inclusions, and other oxidizable ingredients from the surface of the castings. Another reduction cycle takes place by simply reversing the current again, which causes the iron oxide formed in the previous oxidation cycle to be reduced to ferrite.

Following this treatment, the surface of the metal is clean, and, in addition, the microscopic cavities formed by the removal of impurities provide excellent anchorage. Suitable water rinses must be provided to remove excess salt. The tear test illustrated in Fig. 3 shows that cast iron brazed to a steel strip, using the cleaning method just described, breaks in the parent metal rather than at the joint.

In copper-brazing cast iron, the high brazing temperatures employed may cause some difficulties. The melting of low melting point constituents may occur, particularly in light sections within the casting. Again, growth in castings may take place, thereby producing voids or gaps in the brazed joint.

Difficulties such as these indicate that the lower temperatures for brazing may be preferred and, in many instances, Eutectic silver brazing alloy is employed. Not only is a

lower brazing temperature permitted by the use of this brazing alloy, but also there is no loss of zinc, such as would be experienced with the other types of silver alloys. Both zinc and cadmium distillation may occur in brazing alloys that contain these elements because, in furnace brazing, the time factor may be lengthy, due to the mass effect of the cast iron.

The copper alloys can be brazed by furnace, induction, salt-bath, resistance, or torch methods, using either the self-fluxing phosphorus-copper or the silver bearing alloys as brazing materials. Alloys 12 and 13 (see Table 1 on page 168 of April MACHINERY) have been found excellent for brazing the copper-base alloys, having low flow points combined with good strength characteristics. Alloy 12 has been successfully employed in torch-brazing brass to cast bronze, a lap joint being used with a clearance of from 0.0015 to 0.003 inch. Clearances vary according to the flow characteristics of the brazing alloy chosen.

The heat conductivity of copper is quite high,

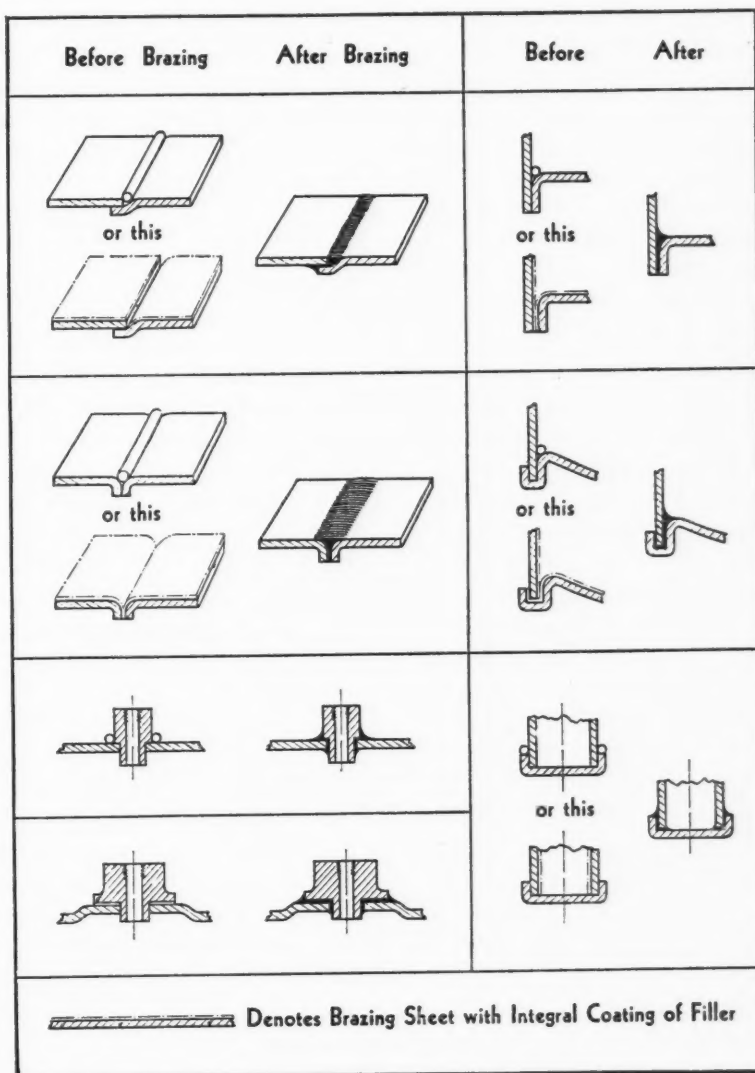


Fig. 4. Typical joints employed in the brazing of aluminum

Table 2. Brazing Materials for Various Aluminum Alloys

Material being Brazed	Filler Material	Application
2S and 3S	No. 716 Brazing Wire or Shims..... 43S Wire	General use Limited use—torch-brazing only
4S and 52S	No. 716 Brazing Wire or Shims.....	Limited use (short joints)—torch-brazing only
53S, 61S, and 63S	No. 716 Brazing Wire or Shims.....	General use
Nos. 1 and 2 Brazing Sheet.....	No. 716 Brazing Wire or Shims..... No. 711 Brazing Sheet*..... 43S Wire	General use
Nos. 11 and 12 Brazing Sheet.....	No. 716 Brazing Wire or Shims..... No. 713 Brazing Sheet*	General use
Nos. 21 and 22 Brazing Sheet.....	No. 716 Brazing Wire or Shims..... No. 713 Brazing Sheet*	General use
*Same composition as brazing coating.		

which means that a greater heat input is needed to bring a copper section to the required brazing temperatures than a low-carbon steel section under identical conditions. Also, where light and heavy sections are adjoining, the general practice is to apply more heat at the heavy section than at the light one to avoid overheating the latter.

Experience has shown that in brazing both yellow brass and 10 per cent nickel-silver—especially in the cold-worked state—the localized heating produced by a torch may cause stress cracks. In brazing these materials, therefore, it is advisable to preheat and then anneal after brazing.

For small quantities of assembly work, torch brazing is ideal, due to its mobility and versatility. Radiant-burner and induction heating permit localized brazing, and a full view of the joint during the brazing operation is provided. Induction brazing permits the correction of misalignment in assemblies, since full vision and accessibility of the joint are possible. Both resistance brazing and salt-bath brazing are limited to individual designs. However, whenever applicable, these methods produce excellent joints. Copper and copper alloys can be brazed in an atmosphere without flux by using brazing alloys free of zinc or cadmium. Brass can be brazed in this manner if it is copper-plated prior to brazing.

The three methods most widely used for brazing aluminum alloys are dip, torch, and furnace brazing. Dipping in a bath of molten flux is used for complicated and difficult brazing assemblies, one prerequisite being that the design of the assembly permit the adequate drainage of salt. Torch brazing is performed by dipping the filler

metal in the flux and melting this material into the joint. Furnace brazing can be performed on closed containers, such as gasoline tanks and refrigerator parts, where the heat of the furnace melts the pre-placed filler metal. Fluxing is required in this case, and venting of the assembly is also necessary.

Lock-seam, tee, line-contact, or lap joints are preferred to butt or scarf joints. The clearances employed will vary with the joint design. For any specific case, experimental work is usually required in the determination of this factor. A clearance of from 0.006 to 0.010 inch is suggested for lap joints less than 1/4 inch long, clearances up to 0.025 inch being used on longer laps.

The design should permit ease of assembly prior to brazing, and closed assemblies should be designed to provide egress of gases during the brazing operation. Typical methods of joining aluminum, as recommended by the Aluminum Co. of America, are illustrated in Fig. 4.

Aluminum alloys of high purity, such as 2S and 3S, are the only wrought non-heat-treatable alloys for which commercial brazing processes have been developed. In designing assemblies of these alloys, the strength of the annealed material should be used, since the brazing temperatures are above the annealing temperatures of these alloys.

Brazing of the copper-aluminum alloys, such as 11S, 14S, 17S, and 24S, is not practical due to the serious reduction in both corrosion resistance and mechanical properties that occurs. The tough, resistant oxide film on the magnesium alloys 52S and 56S makes them ordinarily unsatisfactory, although they can be brazed by special procedures.

Alloys 53S and 61S and Nos. 21 and 22 brazing sheets are heat-treatable alloys that can be brazed successfully. Quenching the assemblies will increase the mechanical properties of the T4 temper, after which the T6 temper can be obtained by aging treatment. The brazing materials recommended by one manufacturer for various aluminum alloys are listed in Table 2. (This data was supplied through the courtesy of the Aluminum Co. of America.)

The removal of foreign matter from these materials is usually sufficient cleaning for torch-brazed joints. In furnace- or dip-brazing methods, however, alloys other than 2S and 3S should be prepared for brazing by an etching type cleaner. This is particularly important in brazing a casting, whether or not the surface has been machined. For 2S and 3S alloys, solvent or degreasing cleaning is satisfactory, except in the case of very complicated parts. The cleaning of alloys 53S and 61S, and Nos. 21 and 22 brazing sheets and cast parts, is done by the etching method. This consists of immersing the parts in a 5 per cent sodium-hydroxide solution for a period of twenty to sixty seconds at a temperature of 150 degrees F. The parts are next rinsed in water and dipped in 10 per cent nitric acid solution, after which another water rinse follows to remove the acid.

In furnace-brazing the aluminum alloys, a protective atmosphere is not advantageous, and fluxes are usually required to protect the assembly. These fluxes consist of mixtures of chlorides and fluorides. Brazing flux No. 33 is probably the most widely used due to its low melting point and its chemical activity, which produce a maximum flow of brazing alloy. It can be used at temperatures below 1300 degrees F. Flux No. 30 has a slightly higher melting point. Both flux No. 53 and No. 34 are also used for this work, but these fluxes are not very active chemically. They are employed to a large extent in the brazing of thin sheet.

In dip brazing, multiple line-contact joints can be made in one operation. The loss of fluxing upon removal of the work from the bath must be expected to some extent, and the life of pots is generally short. Nickel pots are satisfactory, however, and with these a service life of approximately six months can be expected.

In utilizing this method of brazing, a preheat of 900 to 1000 degrees F. is recommended. This prevents localized freezing of salt on the work, distortion, inconsistent joining, and the trapping of flux in small openings. The fluxing bath employed is either No. 34 or No. 53. The time of immersion ranges from thirty seconds to three minutes, depending upon the section size; and

the temperature of the operation is between 1110 and 1185 degrees F., varying according to the alloy being brazed.

Contaminants will enter the bath and periodic cleaning is essential. The replenishment of fluxing salts in the bath to compensate for losses when the work is removed helps maintain its purity. However, it may be necessary to immerse sheet aluminum in the bath occasionally and judge the degree of contamination by its color. This reduces the moisture content within the bath.

Regardless of the method employed in brazing aluminum alloys, the removal of flux is extremely important, due to its corrosive effect on the work. This is accomplished by immersing the work in either a 10 per cent solution of sulphuric acid for a thirty-minute period or a 10 to 15 per cent solution of nitric acid for a period of ten to twenty minutes. If the assembly does not permit immersion, scrubbing is employed, using a 20 per cent nitric acid solution.

Immersion in a mixture containing 10 per cent nitric acid and 1/4 of 1 per cent hydrofluoric acid, operated at room temperature, is said to be effective. Suitable hot and cold rinses should follow these acid baths.

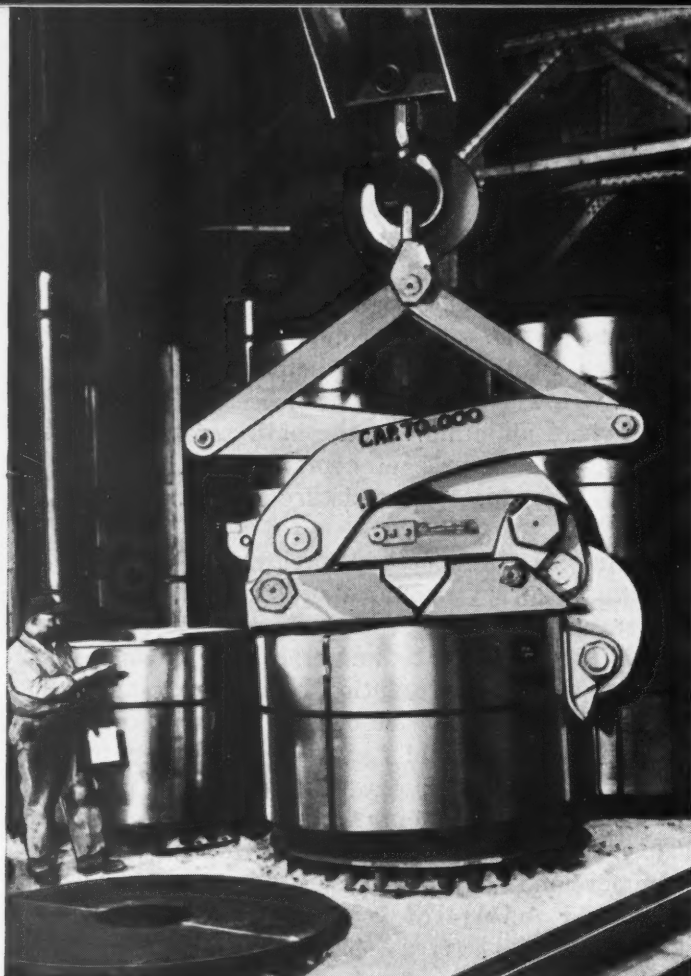
* * *

Molecular Cracks in Aluminum Reduced by Alloying

Aluminum and other metals experience microscopic "earthquakes" within themselves that lead to separation of their internal molecules. Like a chain reaction, these "slips" migrate through alloys. They manifest themselves optically when the metal cracks from fatigue under heavy loads. J. W. Riches and O. D. Sherby, research engineers, and J. E. Dorn, professor of physical metallurgy, all of University of California, Berkeley, discussed these miniature metallic tremors in a paper delivered before a recent meeting of the American Society for Metals. The authors said that molecular cracks may be largely inhibited by alloying aluminum for aircraft with zinc and other metals. For steels, strain hardening was recommended.

* * *

The machine tool industry boosted its employment by almost 55 per cent over its pre-Korean level by July, 1951. It is expected that by the third quarter of 1952, further increases in employment will expand the work force of the industry to about 90,000, or 50 per cent above the mid-1951 figure.



In Shops Around

These powerful coil-handling tongs used at the Gary Sheet and Tin Mill of the United States Steel Co. are believed to have the largest capacity of any in the world. They can pick up coils of strip steel as heavy as 70,000 pounds and carry them safely, without changing the shape of the coils or damaging the edges of the strip. The tongs were designed by the Heppenstall Co., Pittsburgh, Pa.

(Below) Contour welds formerly made with manual apparatus can now be produced with a new Heliarc semi-automatic torch developed by The Linde Air Products Company. Electrically powered rolls drive the filler rod through a flexible conduit into the tungsten arc. The propelling force of the rod moves the torch; the operator only has to guide it along the seam.

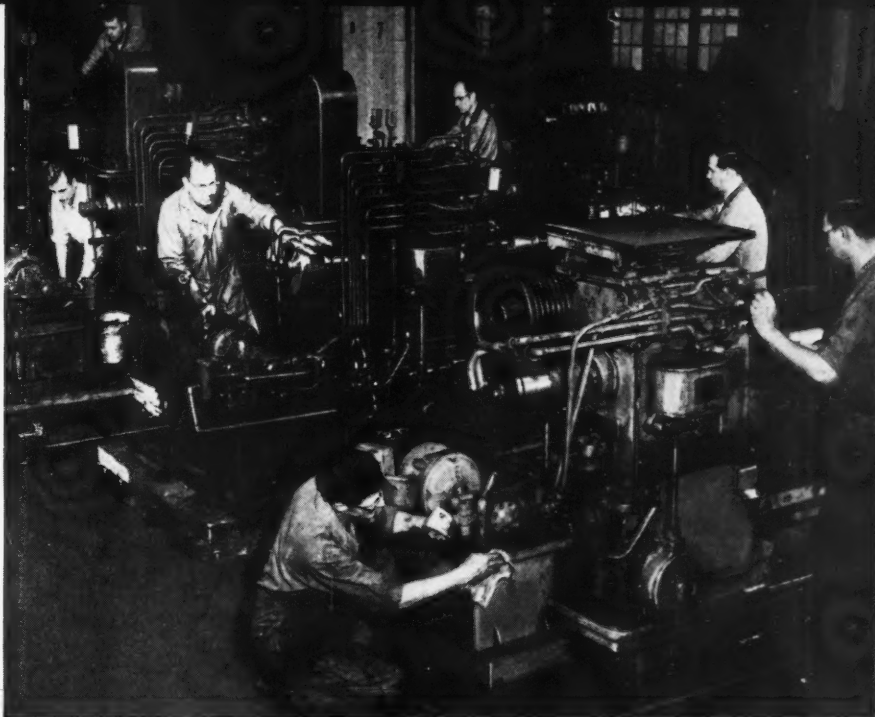


(Below) This Mackintosh-Hemphill rotary straightener recently installed in the Pawtucket, R. I., factory of the Mackenzie Walton Co., redraws 70-30 high brass seamless tubing to exacting specifications. Twelve-foot lengths can be accommodated with a maximum straightness deviation of 1/32 inch per length. Rated output of machine is 120 feet a minute.



d the Country

Camera Highlights of Some
Interesting Operations Per-
formed in Various Metal-
Working Plants throughout
the Nation



Aircraft machine tools from the Air Force pool, put into moth balls at the end of World War II, are being reconditioned on an assembly-line basis by the Buick Motor Division of General Motors Corporation. Buick is tooling up for production of the Wright J65 Sapphire jet engine, and will need 2700 machine tools—above the 500 allocated from the pool—to equip the three large jet-engine plants under construction.

New 42-foot Sellers vertical boring mill being set up to machine a lower bearing bracket for a large hydro-electric generator at the General Electric Co.'s Schenectady Works. This machine, one of the largest removable-rail mills ever built, is so constructed that work can either rotate on the 20-foot table or stay fixed while a cutter assembly rotates inside the work.



Better Quality, Less Inspection with Sequential Sampling Plans

By NORBERT L. ENRICK
P.O.M. Co., Industrial Consultants
New York, N. Y.

IN modern economical mass production, it is considered inevitable that one of the by-products should be defective work—material in various stages of completion that has to be scrapped, salvaged, repaired, or sold as “seconds.” Often, however, lack of adequate records results in underestimating the real cost of defective production. In one plant, for example, it was found that some of the repair work had been accounted for as “miscellaneous indirect labor,” and materials were being scrapped without accounting for them.

Thus, while accounting records may show only 2 or 3 per cent of rejected work in a plant, the true figures may run much higher. This has been demonstrated in many plants in the last few years after statistical methods of quality control were introduced. A serious result of the lack of proper quality control may be the shipment of unsatisfactory merchandise. Even if all of this is not returned, it will undoubtedly cause customer dissatisfaction.

Statistical methods of quality control were first developed in the Bell Telephone Laboratories, and were recommended as having “contributed in a notable way to important reductions in costs and to substantial improvements in quality . . . in the Bell System.” Now these new methods are gaining ever widening popularity by proving their worth both in large and small plants.

The manner in which statistical quality control can achieve both a reduction in inspection and an improvement in quality is by means of scientific sampling inspection of the product immediately following all important processing operations. Two advantages are attained thereby:

1. The sample will reveal bad quality immediately. Thus, the source of defective parts becomes known and can be corrected immediately. The result is better quality because of less defective work.

2. Sampling inspection after all key operations will also detect any quantities of bad work—bad lots—already produced. Such lots are then “detailed” for repair or salvage. Only good lots,

therefore, should reach the final assembly operation. This eliminates the need for time-consuming inspection of every piece before final assembly and shipment. The end result is less inspection because of sampling.

In the past, this method often has not been as successful as it should have been because sampling is subject to a greater margin of error than is usually expected. By chance, an inspector may happen to inspect only good sample pieces from a bad lot, or vice versa. All of this leads to too many wrong decisions—too many bad lots slip through, or too many good lots are rejected.

Here is where the statistics of mathematical probability will help the inspector. These furnish him with a practical sampling plan that results in a minimum amount of inspection for an economical amount of sampling risks. Without this plan, there will usually be either too much inspection or not enough, resulting in too high inspection costs or ineffective quality control.

Thus arises the need for statistical sampling plans based on mathematical probability rather than rule of thumb. The inspector, himself, of course, need not know any details about mathematical probability, as will be shown later. All he does is to follow a sampling plan.

How the Sampling Plan Works

Let us say we have set up for the inspection of metal handles being formed on a drop-hammer, and that production lots consist of 1000 pieces. In this operation, care must be exercised when positioning the parts under the die to avoid misforming and burrs. This is difficult, and even under fair operating conditions, it is not unusual for a lot to contain 2 per cent of defective parts.

This percentage, from an engineering and cost viewpoint, is the “allowable percentage.” Inspection should, therefore, pass lots containing 2 per cent of defective parts, while those containing decidedly more than 2 per cent of defective workpieces should be rejected.

The inspector's job is to take sample pieces at random from each lot, reject the unacceptable

Table 1. Sampling Plan Followed by Inspector

Sample Size (Cumulative)	Acceptance Number (Cumulative)	Rejection Number (Cumulative)
40	0	3
50	1	3
60	1	3
70	1	4
80	3	4

lots, and pass the acceptable ones. To do this, he is no longer expected to guess, but instead follows a definite sampling plan, such as given in Table 1. This table provides the inspector with sets of three important numbers as follows:

1. Sample Size—Number of articles to be examined out of each lot. These must be drawn at random from the lot.

2. Acceptance Number—Number of defective parts allowed in an acceptable lot.

3. Rejection Number—Number of defective parts in a sample that causes the entire lot to be rejected and sent for repair, scrap, or salvage.

The distinctive feature about this table is the gap between the acceptance and rejection numbers. This gap forms an "area of indecision," and if the number of defective parts found in a sample comes within this gap, another sample must be taken. Additional evidence is required. For example, if the inspector has found one defective piece in his first sample of 40 pieces, he can neither accept nor reject the lot, since the acceptance number is 0 and the rejection number is 3. So the inspector must take another sample of 10, bringing his total sample size to 50.

Again the inspector will compare the total number of defective parts found up to this point to determine whether to accept or reject the lot or to continue sampling. This process may go on until the highest sample size (80) is reached, at which point the gap between acceptance and

rejection numbers disappears, and the problem of acceptability is finally solved.

This type of sampling, even though it may require a sequence of samples, has a distinct advantage in that it will generally permit very good lots to be accepted and very bad lots to be rejected after the first or second successive sample. Only lots of "in between" quality will, on

Table 2. Another Inspection Sampling Plan, in which the Chance of Error is Reduced

Sample Size (Cumulative)	Acceptance Number (Cumulative)	Rejection Number (Cumulative)
40	0	3
60	1	4
80	1	5
100	2	5
120	4	5

the average, require more inspection. Thus, statistical quality control makes sure that an absolute minimum of inspecting is done.

Quality Control Value of a Sampling Plan

Obviously, no sampling plan can eliminate all chance of errors, since every piece is not inspected. However, such plans do minimize the risk of error. It should be pointed out that these plans are based on a certain risk, or percentage of error. With the plan outlined, the odds are 1 to 5 that a lot may be accepted, even though it is quite unsatisfactory and should not be allowed to pass. If this risk is considered too great, it can be reduced by doing more sampling. Thus, if it is desired to take a risk of only 1 to 10, Table 2 would apply.

A similar table can be developed for any degree of sampling risk desired. Under many types of mass production, a risk of between 10 and 15

Table 3. Master Table for Setting Up Sampling Plans with Various Percentages of Allowable Defective Parts

Sample Size (Cumulative)	Allowable Defective Parts, Per Cent																			
	1		1.5		2		3		4		5		6		7		8		10	
	Acceptance Number	Rejection Number	Acceptance Number	Rejection Number	Acceptance Number	Rejection Number	Acceptance Number	Rejection Number	Acceptance Number	Rejection Number	Acceptance Number	Rejection Number	Acceptance Number	Rejection Number	Acceptance Number	Rejection Number	Acceptance Number	Rejection Number	Acceptance Number	Rejection Number
40	0	2	0	3	0	3	0	4	1	5	1	5	1	6	1	7	2	8	2	9
60	0	2	0	3	1	4	1	5	2	6	2	7	3	8	3	9	4	10	5	11
80	1	3	1	4	1	5	1	6	3	7	3	8	5	10	5	11	6	12	8	14
100	1	3	2	4	2	5	2	6	4	8	5	9	6	11	7	13	8	14	10	17
120	2	3	3	4	4	5	5	6	7	8	8	9	10	11	12	13	13	14	16	17

Note: Lots should consist of at least 500 pieces and at most 2000 pieces.

per cent is often accepted as reasonable and economical. Table 3 can be used as a master to provide individual sampling plans for allowable percentages of defective parts ranging from 1 to 10. Each individual table involves a chance of roughly 1 out of 10 of accepting (in error) a bad lot.*

Whenever a lot is rejected, there is sufficient cause for a check on the equipment and operator involved. Here, again, scientific sampling plans effect savings. They help production men to avoid, as much as possible, two types of errors that are commonly made: (1) "Shooting" for trouble in the process when no trouble actually exists; and (2) failing to "shoot trouble" in the process when trouble does exist. Thus, time and materials are saved.

* * *

"Profilograph" Equipped to Measure within One-Millionth Inch

How can we measure the smoothness or roughness of a highly polished steel sphere or cylinder? How can we tell how closely a machined steel part approaches a perfect circle? Some time ago the Timken Roller Bearing Co., Canton, Ohio, developed a machine known as the "Profilograph," which could determine with extreme accuracy how rough or how smooth a steel surface actually is.

Recently a further refinement was made in this machine that would seem to make it well qualified to answer the preceding questions. With this new development, shown in the accompanying illustration, it is said to be possible to determine if a piece has been ground to a true or perfect circle by checking both surface finish and geometrical accuracy within a millionth of an

*Additional tables are given in the author's book on "Quality Control," published by THE INDUSTRIAL PRESS.

inch. What one-millionth inch really means will be better understood when we realize that it is forty-six thousand times finer than the thickness of a dime or three thousand times thinner than a single sheet of newspaper.

In operation, the object to be measured is mounted on a flat, delicately adjusted table which is fitted into a special bearing. A hinge is mounted just above the specimen to be measured. At the end of this hinge is a diamond needle and a tiny mirror. The diamond needle rides ever so lightly over the surface of the object while the table on which the specimen is mounted turns.

As the needle rides over the object, any variation in the surface causes the needle, and also the mirror mounted on the hinge, to wiggle. A tiny beam of light is played on the mirror, and as the mirror moves, the beam of light moves also. Through a series of other mirrors, the light beam is transmitted to a photographic film, on which the surface variations are recorded.

From the recordings on this film, it is possible to tell just how rough or how nearly perfect the tapered roller bearings are. By changing the length of the light beam, surface variations can be magnified up to 5000 times their actual size.

* * *

Uses of Chucks Shown in Motion Picture

"Chucks and Their Uses" is the title of a new 16-millimeter, color and sound film released by the Skinner Chuck Co., 344 Church St., New Britain, Conn. Included are scenes showing parts, construction, mounting, and use of independent, universal scroll and power chucks; a study of stresses and strains; tests for run-out and balance; horsepower requirements of machine tools, etc. The film is available to educational and engineering groups without charge.



"Profilograph" equipped by the Timken Roller Bearing Co. to determine accuracy and smoothness of a sphere within one-millionth of an inch

General Electric Co. Dedicates Lockland Jet Center

NEW facilities at Lockland, Ohio, designed for the precision manufacture, assembly, and testing of turbo-jet engines, were recently dedicated by the General Electric Co. The occasion also commemorated the successful completion of the nation's first jet engine ten years ago at the

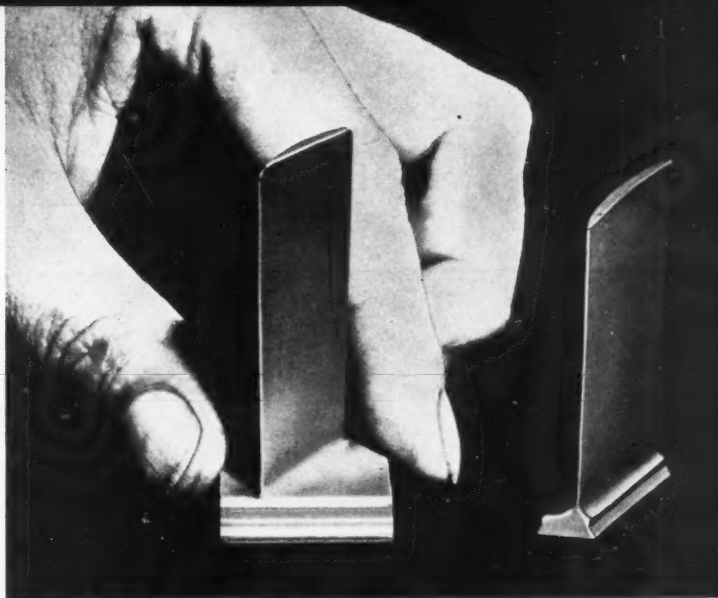


Fig. 1. Fabricated compressor stator blade seen at left is less costly to manufacture and requires less critical materials than forged blade at right.

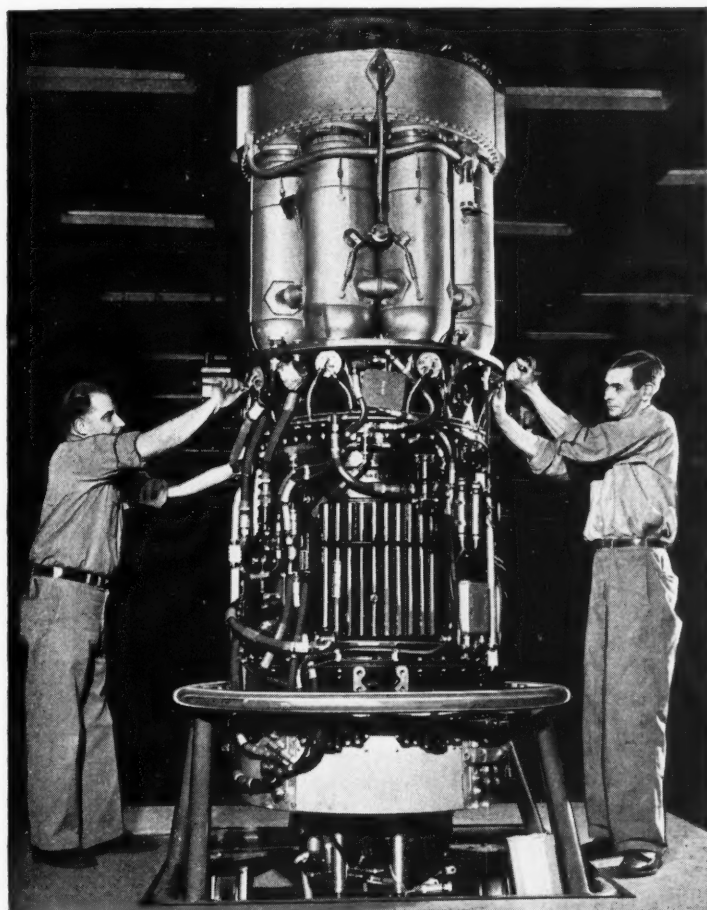


Fig. 2. Vertical instead of horizontal assembly of turbo-jet engines permits better alignment between rotating and stationary parts.

General Electric River Works, Lynn, Mass. During the ceremonies, the 10,145th jet engine produced by the company was delivered to the Air Force.

Among the new techniques disclosed in turbo-jet manufacture is an improved method of making compressor stator blades. It is estimated that the new fabricated blade, shown at the left in Fig. 1, will result in a 55 per cent reduction in manufacturing costs and a 39 per cent saving in critical materials, compared to the forged blade seen at the right. Another innovation is the assembling of the turbo-jet engines in an upright position, as seen in Fig. 2, rather than horizontally. This improved method of assembly has eliminated sag and permitted better alignment between rotating and stationary parts. Precision equipment at the new plant includes the machine shown in Fig. 3, which grinds gear teeth to close tolerances.

Fig. 3. A Swiss-built Reishauer machine grinds gear teeth to close tolerances. Thirty-five gears can be ground before the wheel requires dressing.



Machining and Assembling T

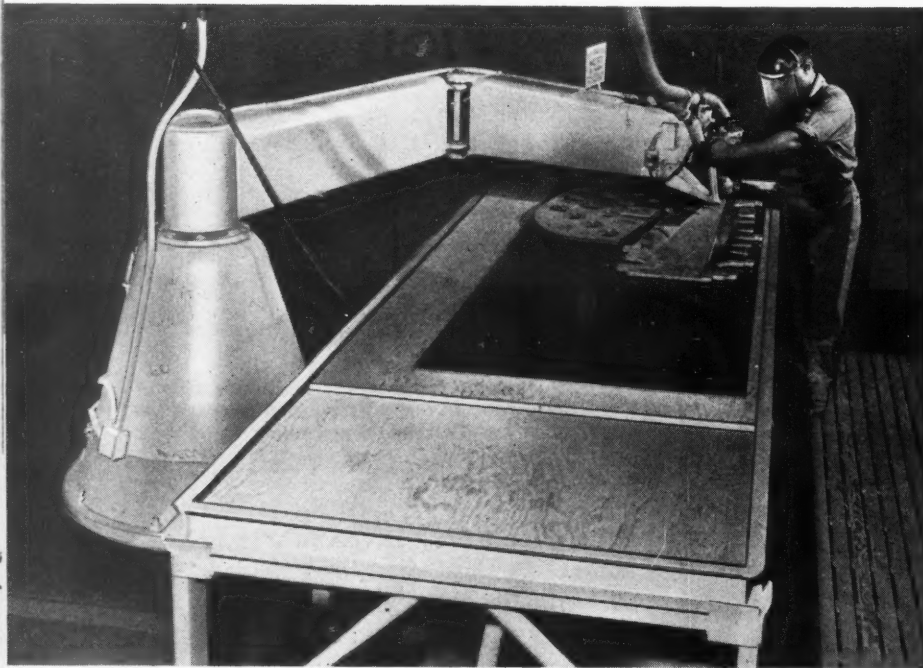


Fig. 1. The radial-arm router is especially advantageous for contour cutting of stacks of laminated plastic sheets.

Drilling, Blanking, and Assembly Procedures, as well as Other Shop Operations on Thermosetting Laminated Plastics—Sixth in a Series of Articles on Postforming

By WILLIAM I. BEACH
Executive Assistant
North American Aviation, Inc.
Los Angeles, Calif.

THE articles previously published in this series, the last of which appeared in December, 1951, *MACHINERY*, have dealt with some of the physical characteristics of fully cured, "C" stage thermosetting laminated plastics, production techniques applied to these materials in postforming, and design of postforming dies. This article will describe machining and assembling operations on postformed thermosetting laminated plastics.

The methods of machining thermosetting plastic laminated components for assembly do not differ essentially from the technique employed by aircraft plants and other metal-working shops in manufacturing aluminum or steel parts. This material is readily handled and processed by conventional tools and machines. With the exception of certain inherent properties not common to other materials—namely, low shearing strength and resiliency which require less rake on cutting tools and higher cutting speeds—the laminates behave like metal, and can be cut, routed, drilled, or trimmed with equal efficiency.

Laminated sheet material is available in various sizes and thicknesses. The utmost care should be exercised in selecting the size that will accommodate the maximum number of parts per

sheet. Often the shape and size of a blank are such that economical use of a sheet is not possible. In this case, it is advisable to cut several different blanks from a sheet, in order to reduce the amount of scrap material. An acceptable procedure is to lay out beforehand an assortment of patterns or templates on a sheet of given size, and scribe the blanks to be cut on the sheet. Following this step, the sheet is set up for cutting the material into various patterns prior to final fabrication.

The choice of a suitable means for cutting the sheet into blanks is dependent upon available facilities, the size of the production runs, and, of course, the anticipated cost of the article. For example, when piece requirements are small, the normal practice is to use a contour saw. On the other hand, when production quantities are sufficiently large to offset tooling costs, it is feasible to employ routers or blanking and piercing dies for cutting and trimming operations.

Routing is the most commonly used method of cutting laminated plastic sheet stock to shape when the part desired is irregular in outline. This is accomplished by means of a motor-driven rotary cutter, guided around a pattern or template, as shown in Figs. 1 and 2. In connection with router pattern design, it is good practice to consider the following recommendations:

Note: The Postforming Process is covered by United States and foreign patents, and pending applications are assigned to North American Aviation, Inc.

Thermosetting Laminated Plastics

1. The minimum inside corner radius is equal to the radius of the standard cutter, or $\frac{5}{32}$ inch.

2. The minimum outside corner radius is $\frac{7}{32}$ inch, since the router pattern is set back $\frac{7}{32}$ inch from the edge of the part. In order to allow for a slight radius on the corners of the router pattern, however, a $\frac{1}{4}$ -inch radius should be specified, as shown in Fig. 2.

3. The smallest recommended size hole to be routed is $\frac{9}{16}$ inch in diameter.

4. At least $\frac{5}{8}$ inch of material should be allowed to remain between routed edges, so that the pattern can withstand the pressure of the follower.

The advantage of using a router is that several sheets can be cut at a time. It is quite common to assemble five to ten sheets in a stack for routing. Although different types of stationary or movable routers are employed for this purpose, the radial-arm router shown in Fig. 1 is probably the most effective machine for this work.

In Fig. 3, a bundle of sheets can be seen secured on a table beneath the router arm. A template is positioned on top of the stack to enable the operator to cut the blanks speedily and accurately to the required profile.

Frequently, fabricated parts need to be trimmed, notched, or otherwise cut out on flat or curved surfaces. Hand routing is particularly suitable for this type of job, as shown in Fig. 4. Here it can be seen that the routing tool consists of a hand drill motor to which is fixed a router-bit adapter. The adapter provides a means for holding the cutting tool and template or pattern follower. The holding fixture is essentially a frame, constructed of strap steel, which, if equipped with drill bushings, can be used as a drill jig as well. Clamps hold the part in place, and guides are located carefully on the fixture to permit accurate trimming or contour routing of the part.

Another efficient method of trimming and cutting laminated material is that referred to as die-cutting. Blanking and piercing are shearing operations performed in a punch press by means of matching punches and dies made to the desired outline. All commonly used laminated plastic sheets can be blanked up to $\frac{1}{4}$ inch maximum thickness. Holes can be pierced if the hole diameter is not less than the material thickness. Blanking is practical only when the quantity of parts required is large. There are many standard shapes, however, for which dies are available. These include round and elongated holes, rounded corners and cut-outs, and in some instances, lightening holes.

Preferably, hole sizes should be specified with fractional dimensions if the standard drawing tolerance of plus or minus $\frac{1}{32}$ inch is allowable. If closer tolerances are required, holes may be dimensioned decimally. The practical limit of

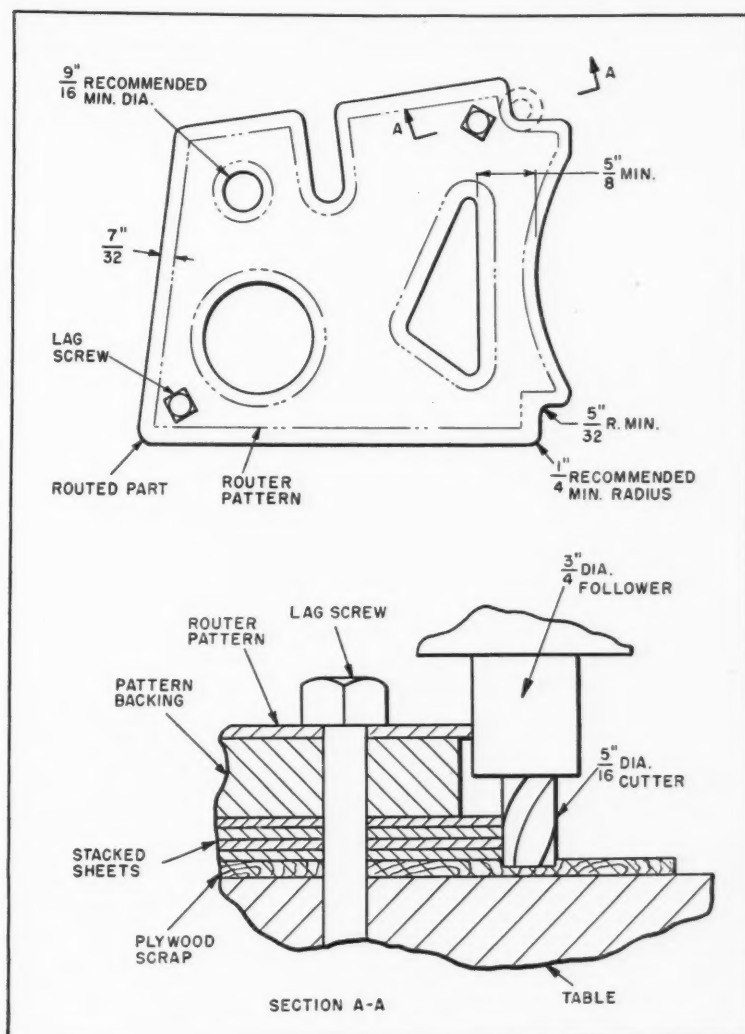


Fig. 2. Routing is the most commonly used method of cutting laminated plastic sheet stock to shape when a part having an irregular contour, such as here shown, is to be produced.

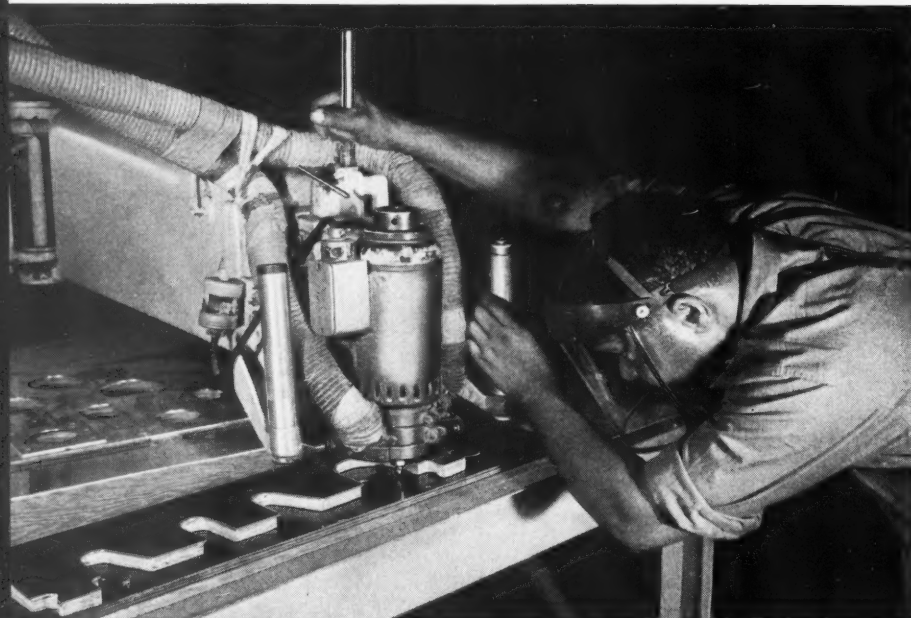


Fig. 3. A template speeds the accurate contour cutting of a stack of laminated plastic sheets, and provides uniform, smooth edges.

accuracy for the diameter of pierced holes is plus 0.06 times the material thickness, minus nothing.

In usual practice, blanking and piercing dies for thermosetting plastic sheet are made 1/2 inch thick with punches 1/2 inch long. If the sheet is 1/16 inch thick or less, a 3/8-inch thick Kirksite die and a 3/8-inch long mild steel punch may be used. The punches and dies are mounted on suitably sized mounting plates. A margin of 1 1/2 to 2 inches around the punch is sufficient for dies 8 by 8 inches and 10 by 14 inches. Larger dies require more margin.

Die and mounting plates (made of Masonite) should be the same thickness to avoid trouble with piercing punches. Die and punch clearance

is approximately 0.0005 inch for sheet thicknesses of 0.015 to 0.032 inch, and 0.0015 inch for sheets from 0.040 to 0.093 inch thick.

These dies can be designed so as to perform single or multiple operations—that is, blanking, or blanking and piercing, and many combinations of these operations. Square or rectangular cut-outs may require a notching die similar to the one shown in Fig. 5. To blank and pierce flat material, a die of the general type shown in Fig. 6 may be used. When trimming or cut-out operations are required on a fabricated part, a die such as illustrated in Fig. 7 is commonly employed. The examples shown represent three basic methods of cutting sheet material with dies. The low shearing strength of thermosetting laminated plastics makes these materials ideally suited for cutting by dies, either on flat or contoured surfaces.

Because shearing is often the most economical way of producing straight cuts in material of this type, it is advantageous to design parts with all edges straight in the flat pattern to permit cutting by shearing if desired. It is also important that outer corners be allowed to remain sharp and notches be avoided as much as possible, since corner design frequently determines the method of cutting. Fig. 8 shows how a flanged part with diagonal edges can be designed to permit shearing by the use of straight cuts in the flat pattern. The effect of the flange position on location of fasteners must be considered.

Fig. 9 shows how a notch can be avoided by the use of one straight cut. Here, again, it is



Fig. 4. Hand routing operations are often used when plastic parts require trimming, notching, or cutting out of flat or curved surfaces.

Fig. 5. Square or rectangular cut-outs may require a notching die similar to the one illustrated.

important to consider the effect of the diagonal cut on the location of fasteners in the shortened flange. Standard cutters of the guillotine type or metal-cutting power shears are satisfactory for both straight and curved cuts.

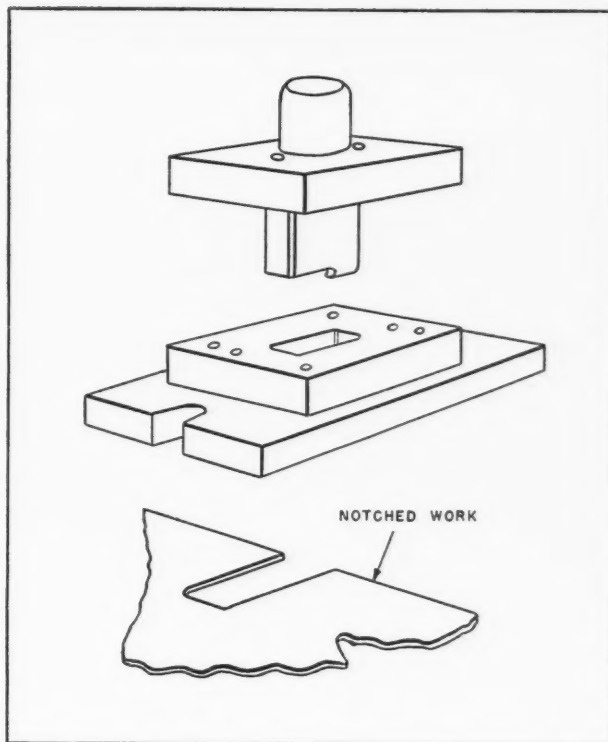
For random cutting of laminated parts where close tolerances and smooth edges are not required, the band saw is recommended. Any standard band saw will be satisfactory for thin-gage material. When thick material is to be cut, the blade must be of hardened steel, with teeth ranging from 4 to 8 per inch, and a cutting speed of approximately 6000 surface feet per minute is required.

Fabricating and Assembling Procedures for Laminated Plastic Parts

In a fabricating shop, the procedure in drilling and fastening component members of a part may vary somewhat for different jobs. Sometimes, in the case of a small, relatively simple, part the attachment holes will be pierced in the flat blank prior to shaping. Or the same part may first be formed, and afterward drilled by hand. The assembling of several parts for matched drilling and riveting can be done on a form block or in a drill and assembly fixture.

The handling of fabricated parts in the manner described entails no special skill or tools. It should be remembered that, while laminated material is considerably more brittle than the various metals, it can be drilled and riveted satisfactorily. In drilling rivet holes, the distance from the edge should be at least twice the rivet diameter, measured from the open edge of the flange. For general work, it is recommended that this distance be three times the rivet diameter. Likewise, rivet holes should not be spaced closer than $\frac{5}{8}$ or $\frac{3}{4}$ inch between centers in a single row. Double-row rivet holes can be safely spaced $\frac{5}{8}$ inch apart, provided adjacent holes are spaced diagonally with respect to each row.

Material in the flat condition can readily be drilled by hand or on drill presses. However, for drilling at-



tachment holes in the members of an assembly, different means are required. For example, an ammunition gun chute is made up of an assembly of different shaped sides fastened to each other with right-angle, straight, or curved flanges. It is seldom possible to drill the flanges of each side separately, with any reasonable expectation of

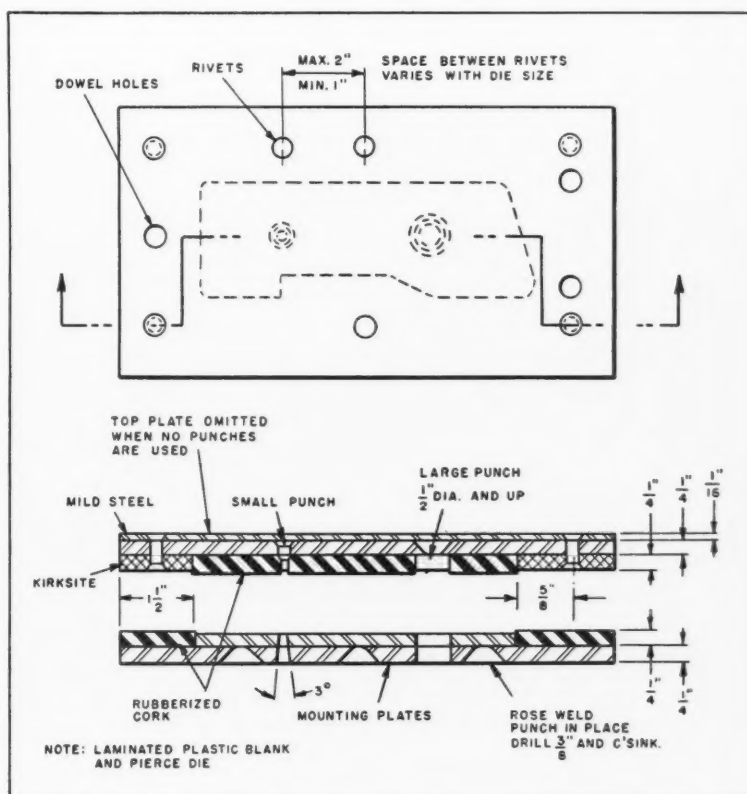


Fig. 6. The general details of a typical blanking and piercing die for flat laminated plastic material are shown here.

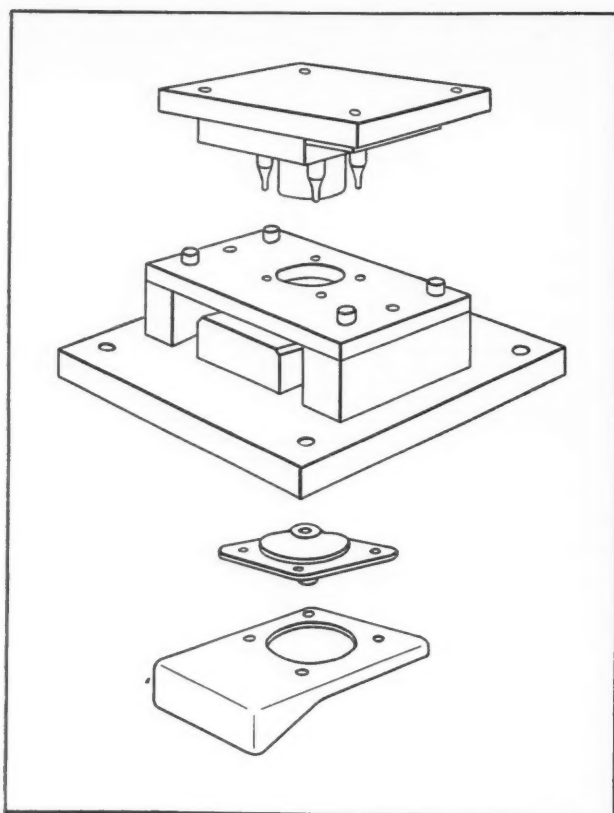


Fig. 7. Fabricated laminated plastic parts are blanked and pierced in dies of this type.

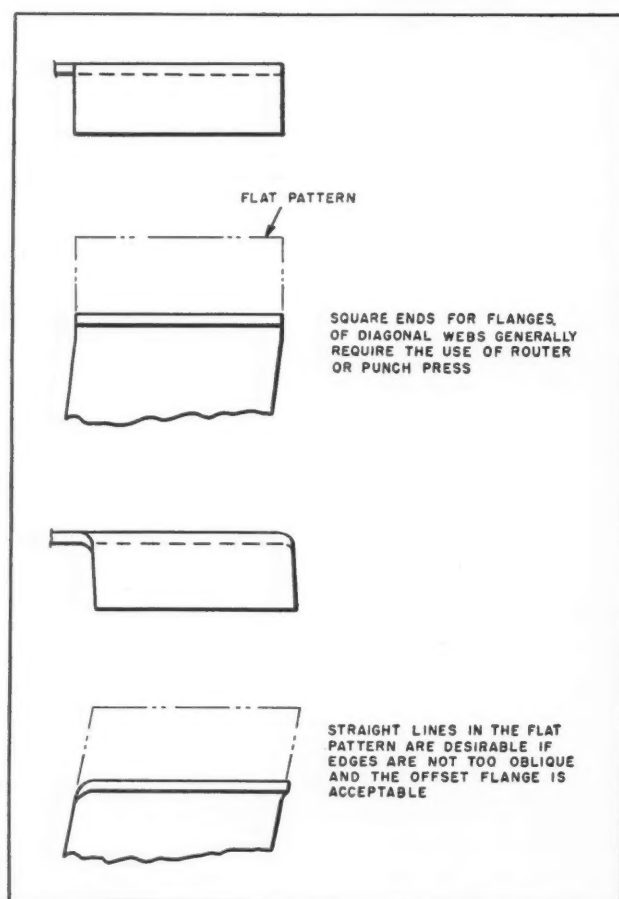


Fig. 8. Fabricated plastic parts should be designed with straight edges, where possible, to permit straight shearing cuts.

matching the attachment holes later in assembly. To insure against misalignment of matching parts, it is standard practice to utilize drill fixtures, or the like. The drill fixture provides a positive means of holding the respective components of the assembly securely in alignment. Furthermore, steel drill bushing inserts, located in a drill pattern throughout the structure, permit the drilling of clean, accurately spaced holes.

Thus from the standpoint of production efficiency, there is less tendency for bad workmanship when fixtures, such as the one shown in Fig. 10, are used. Although the particular drill fixture illustrated may appear unnecessarily elaborate, it was designed for drilling approximately sixty matching attachment holes in six pieces having different contours.

By and large, the majority of drilling and riveting is done on small hand forms, making good use of bench tools. Many parts that require the attachment of small metal parts, or the assembly of one or more members, can be handled satisfactorily on common hard wood forms. It is customary to position the several members on the form and clamp them together for hand drilling and riveting. In some instances, a suitable wood form may be held in a bench vise for this purpose. While numerous parts are fabricated in this manner, the labor involved may warrant a more efficient arrangement, such as shown in Fig. 11. The adjustment and alignment features of this fixture save time and reduce direct labor costs. Also, positive holding fixtures such as this tend to minimize part rejection or reworking operations.

A convenient arrangement for drilling, riveting, and assembly work may be seen in Figs. 12 and 13. Here the holding and assembly fixture is mounted on a stand which has additional adjustments and releases for expediting the work. The small clamps shown in these illustrations are typical "skin clamps," used to hold the pieces together prior to final riveting.

Standard AN-24S-T aluminum rivets may be used to assemble laminated plastic to plastic or plastic to metal. However, in riveting by the conventional rivet gun and bucking-bar method, some care must be exercised to see that the head of the rivet is properly upset. The laminated resinous material is much more brittle than metal, and will not stand rivet gun pressure for too long a period. To hold the gun on the rivet after the head is upset is likely to create buckling in the shank of the rivet. Since thermosetting laminates possess practically no yielding property in the cold condition, buckling of the rivet may well introduce bearing failure in the hole, resulting in material cracks around the hole.

Whenever feasible, either with hard or soft rivets, it is preferable to employ squeeze riveting methods, as illustrated in Fig. 14. Occasionally, for jobs other than aircraft work, hollow tube copper or aluminum rivets may be used. These are advantageous in minimizing rivet damage to the material.

The accompanying table gives recommended conditions for riveting laminated (fabric-base) plastic sheet, using AN-442AD4 rivets and 8000 pounds per square inch pressure, both in warp and filler directions. The best drill size for the No. 4 rivet is No. 29 wire gage (0.1360 inch diameter); and for the No. 3 rivet, No. 40 wire gage (0.0980 inch diameter). The drill size considerably affects the efficiency of the joint, either by increasing the concentration of bearing stress when too large or by crazing when too small. Calculations and test results indicate that a stress concentration factor of 2.5 should be used in estimating the tensile strength of the laminated material when riveted structures are being designed.

Another method of fastening parts together is by metal stitching. The specifications for stitching laminated plastic to plastic or to metal include the following general requirements:

1. When a non-metallic material is stitched to a metal part, it is preferable that the non-metallic material (the thicker or harder metal, if all metal) be on top of the combination.
2. When stitched assemblies are to be used at temperatures exceeding 400 degrees F., stainless steel wire having a tensile strength of 290,000 pounds per square inch should be used in place of zinc-coated AN-W-13 wire.
3. When the design of a part requires the crown of the staple to be located on a specific side of the work, a note should specify: "Clinch on bottom" or "Clinch on top."

The recommended minimum distance between any point on one staple and the corresponding point on another in a row where the stitches are parallel to the row is $\frac{3}{4}$ inch; however, 0.707 inch is permissible. The minimum spacing between parallel rows of stitches is usually $\frac{1}{8}$ inch, although $\frac{1}{4}$ inch is better. When parallel rows of stitching are used, staggered spacing of the staples is recommended. The spacing of stitches should be held to plus or minus $\frac{1}{32}$ inch, but in general practice, more generous tolerances are employed.

Gluing of laminated plastic to plastic or to metal is not usually acceptable for fabricated parts. The tensile strength of the glue line is low, and there does not appear to be any practical means of determining the degree of bond between adjacent surfaces. For this reason,

Recommended Conditions for Riveting Fabric-Base Laminated Plastic Sheet

Nominal Sheet Thickness, Inch	Edge Distance (Number of Hole Diameters)	Center-to-Center Distance (Number of Hole Diameters)	Maximum Allowable Load per Rivet, Pounds
1/16	2	6 to 10	120
1/16	3	6 to 10	140
3/32	2	6 to 10	220
3/32	3	8 to 14	260

Note: Based on the use of AN442AD4 rivets and 8000 pounds per square inch pressure in both the warp and filler directions.

gluing technique is frowned upon in certain industries. However, laminated plastic may be glued to wood satisfactorily in certain applications, such as, for example, drain surfaces, table

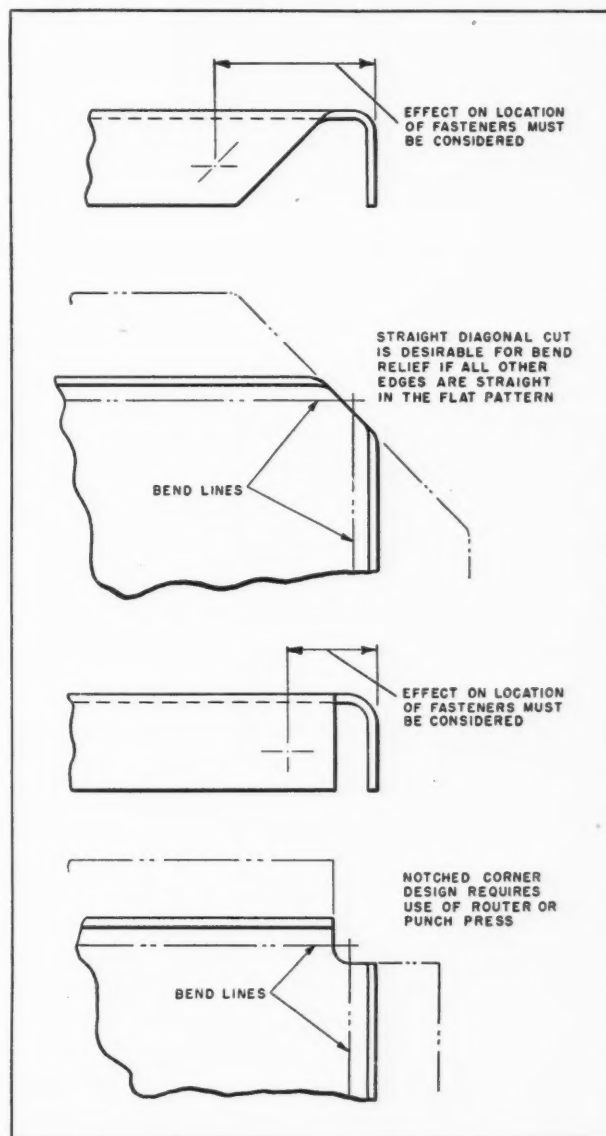


Fig. 9. Notches can be avoided in some designs of plastic parts by a straight cut, thereby eliminating the use of a router or punch press.

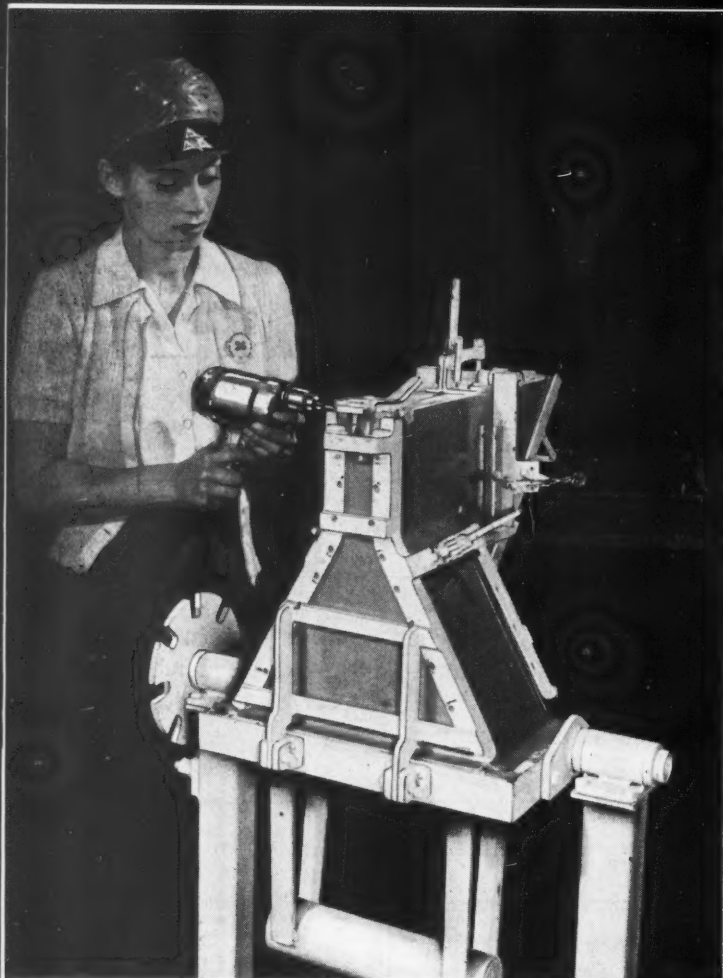


Fig. 11. A positive holding fixture for drilling and riveting laminated plastic parts provides a high degree of alignment and adjustment.

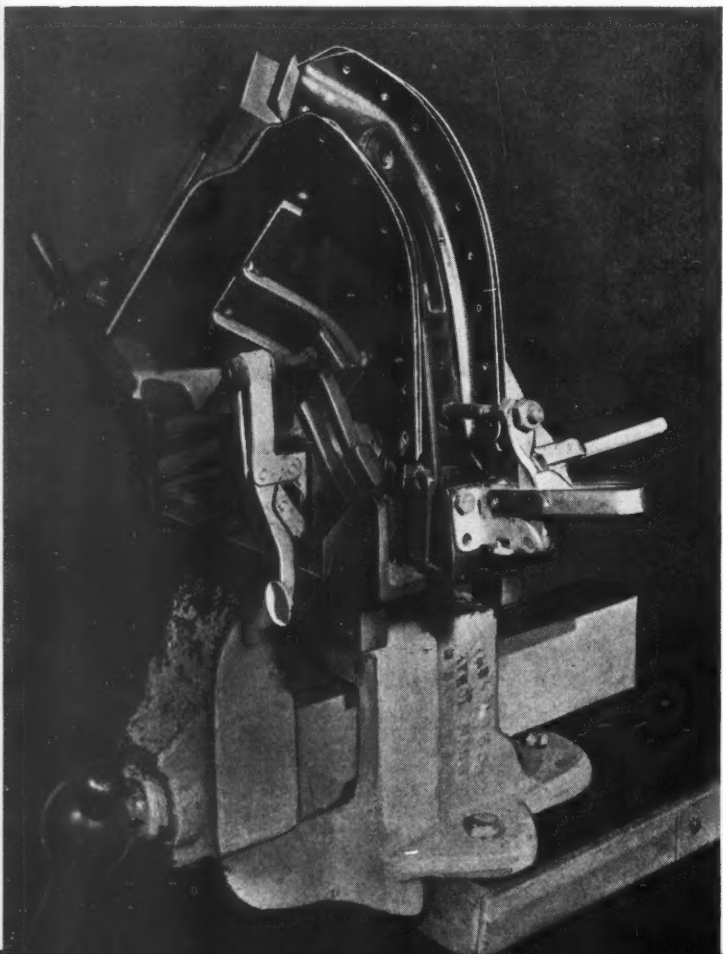


Fig. 10. Fixtures for drilling fabricated laminated plastic parts insure the alignment of holes in assembling mating pieces.

tops, wall panels, etc. In the majority of cases, a resorcinol type of adhesive is employed for bonding purposes.

Finishing and Reworking Laminated Plastic Parts

Laminated plastic material can be obtained in semi-glossy or glossy satin finish. Little needs to be done to the surface except when a color other than the natural tan, black, or dark green is required—in which case the material must be painted. Paint will adhere to the surface reasonably well provided certain preparations are made beforehand.

Since the surface is hard and usually glossy, it should be sanded carefully with fine-grain paper. Dust or any grease on the surface should be removed. Following this, a durable primer coat should be spread on the surface and allowed to dry thoroughly. Sometimes it is advisable to sand the primer coat lightly, after which an enamel or lacquer paint may be brushed or sprayed on and allowed to dry.

The need for reworking a part, aside from a major discrepancy in fabrication, which may be cause for rejection, is almost always the result of employee carelessness or material defects. Occasionally, rivet holes are drilled too close to the edge of an open flange, causing the material to tear at the hole or cracks to develop when riveting. In such an event, the part can often be saved by drilling out the rivet and riveting with flat washers underneath the head.

If a crack develops in the material and is not near an open edge, a No. 50 drill hole (0.070 inch in diameter) at each end of the crack will probably prevent it from doing further damage. Other means are used to reinforce cracked flanges. Thin metal corner angles or gusset plates riveted to the damaged area are sometimes acceptable if the appearance is not objectionable. These and many other forms of repairs are customary methods of saving damaged parts.

Material defects in the form of delamination, cracks, crazing, and blistering are usually, but not always, cause for rejection of parts. The requirements according to aircraft standards are noted below:

1. Delamination (separation of layers) shall be cause for rejection of any part.
2. There shall be no cracks except as listed under (A), (B), and (C), and they shall be arrested by drilling a No. 50 (0.070 inch diameter)



Fig. 12. A holding and assembly fixture mounted on a stand with additional adjustment and releasing features expedites drilling and riveting operations on fabricated plastic parts.



Fig. 13. This close-up view of the fixture illustrated in Fig. 12 shows the small "skin clamps" used to hold the parts together prior to performing the riveting operation.

hole at each end. (A) A crack less than 1 inch long. (B) A crack not more than one layer deep. (C) A crack that does not extend to the edge of the part.

3. Blisters shall be cause for rejection when a whole blister or a cluster of blisters exceeds 1/2 inch in diameter.

4. Where cracks and blisters are permissible, they shall not impair the usefulness, the means of attachment, or any other subsequent manipulation of the part.

Subsequent articles will deal with standard specifications and performance characteristics of laminated plastics and typical applications.

* * *

Industry statistics on employment, hourly and weekly earnings, and weekly hours are available each month from a vast reporting program conducted by the United States Labor Department's Bureau of Labor Statistics.

Fig. 14. Squeeze riveting methods are preferred in assembling parts made of thermosetting laminated plastic because this material has practically no yielding property in the cold condition.



Materials

OF INDUSTRY

The Properties and New Applications of
Materials Used in the Mechanical Industries

Mechanical Properties of "Incoloy," an Alloy that Conserves Nickel

Data on the mechanical properties at room temperature of standard forms of "Incoloy"—a new heat- and corrosion-resistant alloy announced in November, 1951, MACHINERY—have been released by the International Nickel Co., 67 Wall St., New York 5, N. Y. This alloy, which contains only 34 per cent nickel, was developed to serve some of the purposes filled by the company's older alloys containing a high percentage of nickel, such as "Inconel," which contains 77 per cent.

It is stated that the new alloy has high resistance to cracking under drastic temperature changes, as indicated by its coefficient of expan-

sion. No tendency to become embrittled after prolonged exposure to intermediate temperatures is evidenced. At room temperatures, its tensile properties and hardness in the annealed condition fall within the nominal range of tensile properties and hardness of annealed "Inconel."

The rates of work-hardening of these two alloys are practically identical. Like the old, the new alloy can be welded by standard methods.

Compound that Dries Metals by Water Displacement

A water-shedding compound known as water displacing liquid No. 51 has been introduced by Enthone, Inc., 442 Elm St., New Haven, Conn.,

Mechanical Property Ranges of Standard Forms of "Incoloy" at Room Temperature

Form and Condition	Tensile Properties				
	Tensile Strength, Pounds per Square Inch	Yield Strength, Pounds per Square Inch (0.2 Per Cent Offset)	Elongation in 2 Inches, Per Cent	Hardness	
				Brinell (3000 Kilo- grams)	Rockwell
Rod and Bar					
Cold-drawn					
Annealed	75,000-100,000	30,000-55,000	50-30	120-170	66-86B
As drawn	100,000-150,000	80,000-125,000	30-10	180-290	90B-30C
Hot-Rolled					
Annealed	75,000-100,000	30,000-55,000	50-30	120-170	66-86B
As rolled	80,000-120,000	35,000-90,000	50-25	135-220	74-96B
Forged	80,000-120,000	35,000-90,000	50-25	135-220	74-96B
Wire					
Cold-drawn, Annealed	75,000-105,000	25,000-55,000	50-25	.....	.....
Plate					
Hot-rolled					
Annealed	75,000-105,000	30,000-55,000	50-30	120-180	.....
As rolled	80,000-120,000	35,000-90,000	50-25	135-220	.....
Sheet					
Cold-rolled					
Annealed	75,000-100,000	30,000-55,000	50-30	.....	88B (Max.)
Deep-drawing and spinning quality	75,000-100,000	30,000-45,000	55-35	.....	80B (Max.)
Strip					
Cold-rolled					
Annealed	75,000-100,000	30,000-50,000	50-30	.....	84B (Max.)
Deep-drawing and spinning quality	75,000-100,000	30,000-45,000	55-35	.....	80B (Max.)
Tubing					
Cold-drawn, Annealed	75,000-100,000	30,000-55,000	50-30	.....	88B (Max.)

(Department M). This product is a liquid of low density, designed to displace water films from the surface of any metal, thus effecting rapid, stain-free drying. The water is quickly repelled from the metal surfaces and settles at the bottom of the container.

Water can be forced out of crevices and holes in the parts by slight agitation. Tarnishing, staining, and deposition of solid residues are said to be prevented by the thin film remaining after evaporation of the solvent at room temperature. This film can be removed conveniently by vapor or liquid solvent degreasing if a perfectly clean surface is required, such as for lacquering or enameling.

The film is compatible with most rustproofing and lubricating oils, and treated parts can therefore be transferred without delay to the rustproofing or lubricating oil normally used. This compound provides a convenient means of drying phosphated coatings that have a great tendency to retain water.

Rapid Acting Steel-Deburring and Barrel-Finishing Compound

Blue Magic Chemical Specialties Co., 2135 Margaret St., Philadelphia 24, Pa., has recently added to its line a highly concentrated, non-dusting, white granular compound for deburring and barrel finishing. This compound, designated No. S-12, is said to reduce deburring and finishing time substantially. It is also a good temporary rust inhibitor.

"Ion-Kote" — a New Compound that Prepares Metals for Painting

A cleaning and phosphatizing compound called "Ion-Kote," used to prepare steel and other metals for painting, has been developed by the DuBois Co., Cincinnati 3, Ohio. It is a white, granular, dustless powder that is applied by spray washers.

The new cleaner is said to remove most cutting and forming compounds, as well as rust preventives, smut, and other dirt. It deposits a hard, dust-free phosphate coating on the metal, which prevents rusting and increases paint adherence.

Stripping Oil for Hot-Dip Tin and Terne Plating

Archer-Daniels-Midland, Cleveland, Ohio, has brought out a new oil-stripping medium for hot-dip tin and terne plating. This material is said to be so stable that decomposition is negligible.

Cold-Spray Bonding Solution for Product Finishes

"Phospray" is a new cold-spray bonding solution developed by the Du-Lite Chemical Corporation, Middletown, Conn. It is applied by the use of ordinary spray equipment without requiring such preparatory steps as cleaning, rinsing, drying, etc. After being sprayed on the product, it dries immediately, ready for the final finish. The new bonding solution is applicable on all metals except aluminum. It can be used in the proportion of three parts of thinner to one part of solution without reducing its effectiveness.

Sulphur-Base Cutting Fluids for Stainless Steels

Sulphur-base cutting fluids for machining operations on stainless steel, high-carbon steels, and other metals that are difficult to machine have recently been announced by the Magnus Chemical Co., Inc., Lubricants Division, Department M, Garwood, N. J. These cutting compounds are applicable on a variety of operations. For difficult machining operations, No. 7 compound is used in undiluted form, but for moderately difficult jobs, it may be diluted. When staining of copper is to be avoided, No. 6 is recommended.

For difficult machining jobs where cooling is an important factor, DO-4A and DO-1A are recommended. These soluble oils are also formulated to give good rust protection and minimize the occurrence of rancidity and dermatitis. They do not "gum up" in service. For most jobs, DO-4A is recommended. When staining of copper is to be avoided, DO-1A is recommended. Both products are diluted in the ratio of 1 to 5 to 1 to 20 for machining operations, depending on the job, and in the ratio of 1 to 35 to 1 to 45 for grinding.

Anti-Rust Paint Can be Applied with Little Surface Preparation

Rusted surfaces can be sealed and further rusting action retarded by the use of a new anti-rust paint known as "Rust-Cure." This paint, which is a product of the Monroe Co., Inc., 10703 Quebec Ave., Cleveland 6, Ohio, can be applied on rusted surfaces without wire-brushing, scraping, or sand-blasting. Brush, dip, or spray methods may be used. The surface to be treated is wiped off to remove loose rust and dirt, after which any grease or oil is removed by steam or a solvent. The paint is available in black, aluminum, and clear compositions. Uses include the protection of machinery and buildings.

How Oils Should be Used in Metal-Cutting and Grinding

By LEE BALLARD
Tide Water Associated Oil Co.
New York, N. Y.

IN the machining of metals, it is generally necessary to use a cutting fluid that serves both as a lubricant and as a coolant. The degree to which the lubricating or the cooling requirement predominates depends upon the metal and the machining operation. The performance of a cutting fluid in any specific operation is influenced by many factors, including type of machining operation, machinability of the metal and its susceptibility to corrosion or tarnishing, cutting speeds and feeds, and type of finish desired.

The life of a cutting tool, or the number of work-pieces that can be produced before regrinding is necessary, is influenced to a considerable extent by the cutting fluid employed. However, the tool must be correctly ground for the operation if optimum life is to be obtained.

In grinding operations, where considerable heat is generated, the primary functions of the cutting fluid are cooling and dissipation of the heat, flushing away chips, keeping the wheel clean and free-cutting, and preventing corrosion.

In general machining, cutting fluids perform one or more of the following primary functions, depending upon the operation involved: (1) Providing lubrication between tool and work. (2) Cooling the tool and the work. (3) Protecting the metal against corrosion. (4) Flushing away the chips. Also, suitable cutting fluids perform the secondary functions of minimizing power consumed in cutting, prolonging tool life, and providing a good finish and accurate dimensions.

Types of Cutting Fluids in Common Use and Factors Influencing Their Selection

The types of cutting fluids in common use are: (1) alkaline solutions; (2) soluble or water-mixable oils; (3) heavy-duty soluble oils; (4) straight mineral oils; (5) fatty oils; (6) blends of fatty and mineral oils; (7) sulphurized mineral oils or blends containing chlorine compounds (usually in combination with sulphur); and (8) mineral oils fortified by various synthetic materials, of which certain phosphorus and nitrogen compounds are examples.

Any sulphurized oil containing even minute traces of free sulphur will tarnish alloys of copper. Such oils should not be used with copper and its alloys when tarnishing of the work or machine parts is objectionable. Sulphurized oils of the non-corrosive type, however, may be used with any type of metal.

The kind of metal and the machining operation are the principal factors influencing selection of a cutting fluid. As a general rule, soluble-oil emulsions are applicable where cooling requirements predominate, and compounded or sulphurized oils where lubrication between the tool and chip is of maximum importance.

In the selection of the oil, one of the most practical guides is the shape of the chip. A long curling chip that bears heavily on the tool indicates tough material requiring a heavily sulphurized or equivalent type of oil. If the chip bears hard, but breaks off just above the tool, a lightly sulphurized oil, or the equivalent, is satisfactory. Friable materials, such as cast irons, that do not produce chips bearing on the tool with any great force may be machined with a soluble oil, or even dry in many instances.

Oils Suitable for Use in Machining Steels and Copper Alloys

As the percentage of carbon in carbon steels increases, the machinability properties become poorer. Low-carbon steels are readily machined in most cases with a lightly sulphurized oil. Increased percentages of carbon require corresponding increases in the amount of surface-active ingredient in the cutting fluid. Alloy steels, corrosion-resisting steels, and Monel metal usually produce long curling chips that bear heavily on the tool, thereby requiring relatively heavily sulphurized oils.

Free-cutting alloys of copper, such as leaded copper, leaded brass, and free-cutting yellow brass, may be machined with a low-viscosity mineral oil or with a soluble-oil emulsion. Readily machinable alloys of copper, such as red and yellow brass, manganese bronze, Muntz metal, Tobin bronze, and leaded nickel-silver, may be

machined with a non-corrosive sulphurized oil containing about 0.5 per cent added sulphur or with compounded mineral oils containing from 5 to 15 per cent fatty oil. Copper, itself, and its tough alloys, such as commercial bronze, phosphor-bronze, nickel-silver, and copper-aluminum alloys, may be machined with non-corrosive sulphurized oil containing from 1.0 to 3.0 per cent of added sulphur or compounded oils with from 10 to 20 per cent fatty oil.

Selection of Oils for Use on Aluminum and Magnesium

Aluminum and its alloys, except those high in silicon content, are readily machined. The free-machining alloys may be machined with a light mineral oil or a soluble-oil emulsion. Highly alkaline soluble oils are to be avoided. Alloys of poorer machinability require a low-viscosity oil fortified by an oiliness or wetting agent. The latter type of oil is suitable for practically all aluminum alloys, as well as for white metals (zinc and its alloys), and is generally found superior to a soluble oil.

Aluminum is machined at much higher speeds than steel. The tools should be ground so that a slicing action is obtained, considerably more side and top rake being needed for aluminum than for steel. Clearance should be large enough to prevent rubbing, but too large a clearance may cause chattering.

Magnesium, and alloys high in magnesium, should be machined with a very low-viscosity oil. Soluble oils should not be used because of the fire hazard resulting from the affinity of magnesium for water.

Dilute emulsions containing from fifty to over one hundred parts of water to one part of soluble oil are employed for surface and cylindrical grinding, and less dilute emulsions for centerless grinding. For thread and form grinding, sulphurized oils of the non-soluble type are more desirable than emulsions.

Honing is a special surface finishing operation that requires a low-viscosity cutting fluid, preferably one fortified by a sulphurized base or other suitable additives. A cutting oil of the type commonly used for machining aluminum is generally suitable for honing ferrous metals. Also, a non-corrosive sulphurized-base type of cutting oil containing from 4 to 5 per cent of added sulphur, which is cut back with from one-half part to equal parts of kerosene, will give satisfactory results on this type of work.

In emulsifying soluble oils for metal cutting and grinding, the oil should always be added to the water, in order to obtain the desired type of

emulsion. If water is added to the oil, an unstable emulsion may be obtained.

Hard water, or that having an acid reaction, tends to cause unstable emulsions and rusting of steel. If rusting of the work or machine occurs, or if the emulsion is unstable, the use of about 0.5 ounce of soda ash or tri-sodium phosphate per gallon of emulsion will usually soften the water sufficiently to overcome the difficulty. When the water hardness is known, in terms of grains per gallon, a general rule is to add about 1.5 ounces of water softening agent per 100 gallons of emulsion per grain of hardness.

Most soluble-oil emulsions are broken by admixture with strong acids or other materials, such as a concentrated sal-ammonia (ammonium-chloride) solution. This offers a convenient means for testing the strength of emulsions in service. If a measured sample of emulsion is placed in a graduated glass container and the emulsion broken by acid or a sal-ammoniac solution, the amount of separated oil can be readily determined and the proportions of oil to water computed on the basis of the quantity of emulsion initially present. A period of several hours may be required to secure complete separation.

Application of Heavy-Duty Soluble Oils

A "heavy-duty" soluble oil is one containing an extreme pressure additive which permits the use of an emulsion for machining and grinding operations that would otherwise require a non-soluble type. Emulsions made with this type of oil have excellent load carrying characteristics in addition to good cooling properties.

A heavy-duty soluble oil will not replace conventional sulphurized or equivalent type oils for severe operations. However, in many operations on free-cutting steels, including hobbing, milling, turning, drilling, boring, and sawing, tool life at least equal to that obtained with a non-soluble oil is possible with a suitable heavy-duty soluble oil. A ratio of one part of heavy-duty soluble oil to fifteen parts of water will take care of most requirements. For the less severe jobs of milling, drilling, turning, and boring, thirty parts of water generally will be satisfactory.

Cutting oils that are non-corrosive to copper and its alloys and have good stability properties and suitable viscosity characteristics may also be used as machine tool lubricants. In automatic screw machines, it is particularly desirable to use one oil for both cooling and lubrication because of the ever present possibility of leakage of the lubricating oil into the cutting oil system, thereby decreasing the effectiveness of the latter.

A heavy-duty soluble oil, when not diluted with more than twenty parts of water, is also suitable for the two purposes, but care should be taken that an emulsion is not recommended for lubrication of machines equipped with clutch discs and other parts made of fiber or any material which is not completely water-resistant.

Prevention of Skin Infection Resulting from the Use of Cutting Fluids

Skin infection, or dermatitis, sometimes occurs among users of cutting fluids, although the fluid itself is seldom responsible, except as a carrier and culture for germs or bacteria introduced from an outside source. In such cases, it is imperative that prompt action be taken to trace the trouble to its source. Simple but effective preventive measures will usually eliminate the possibility of skin troubles.

Most commercial cutting oils are sterile when received by the customer, and do not contain any ingredients harmful to normal human skins. It should be remembered, however, that dermatitis may develop in predisposed persons as the result of continued exposure to any material to which they may be allergic. When it is found that a person is predisposed to skin troubles, he should be transferred to work that does not require handling cutting fluids.

Cleanliness of hands, arms, and clothing is the most important single factor in preventing skin troubles. The liberal use of a neutral soap before quitting work for meals or for the day will

usually prevent an epidemic of dermatitis. Care should also be taken to change and clean work clothing at least once a week. The latter is important, as any oil that remains on clothing for an appreciable period of time picks up dirt and dust and tends to harden. Continued rubbing of the skin by oil or dirt-hardened clothing may cause skin eruptions, as the result of irritation—regardless of how neutral the oil may be. Several hand creams are on the market that are effective in preventing industrial dermatitis, when supplemented by personal cleanliness.

The first, and most important, thing to do in investigating skin infections is to recommend that all affected personnel be relieved from work or transferred to another job until cured; otherwise, control and elimination of the trouble are difficult. The next step is to drain and replace, or sterilize, the cutting fluid, so as to eliminate all living germs or bacteria. The final step is to institute cleanliness habits, which will stop the epidemic and prevent its recurrence.

Cutting fluids may be disinfected by heat or by the use of germicides. Heating to the pasteurization temperature of 140 to 180 degrees F. (60 to 82 degrees C.) for a period of from thirty minutes to one hour will usually disinfect the oil. A temperature above 180 degrees F. is required for true sterilization, and this is preferable with all except water-mixable oils. An emulsion will usually be unstable if heated to the sterilization temperature, and it is preferable to discard it rather than attempt to sterilize it by heating.



Newly elected officers of American Society of Tool Engineers as they met informally for the first time. Left to right (Front), Gerald A. Rogers, assistant secretary-treasurer; Roger F. Waindle, first vice-president; Leslie B. Bellamy, president; J. P. Crosby, second vice-president; H. E. Collins, secretary; and Harry B. Osborn, Jr., third vice-president. (Rear) Harry E. Conrad, executive secretary

INGENIOUS

Mechanisms

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Mechanism that Produces an Intermittent Rotary Motion

By L. A. ERICKSON

The driven member of the mechanism here illustrated consists of a six-toothed gear with members A_3 and B_3 and wrist-pin C . The driving member is made up of two circular plates A_2 and B_2 keyed to the drive-shaft. With these members designed as shown, the driven wrist-pin C and the six-tooth gear will be rotated one-half revolution in the direction indicated by the arrow and caused to dwell while the continuously rotating driving shaft completes one revolution. The wrist-pin then rotates one-half revolution and dwells at its original starting position while the drive-shaft continues to rotate. When the drive-shaft has made another one-half revolution, the cycle described is repeated.

Thus, the driving shaft makes one and one-half revolutions for each complete revolution of the driven wrist-pin C , although the speed of the wrist-pin between the dwell periods is the same as that of the driving shaft. Since the driving shaft rotates at a speed of 90 R.P.M., the driven wrist-pin will make only 60 complete revolutions in one minute.

Referring to the design of the mechanism, the six-tooth gear has alternate teeth in adjacent planes. That is, the three teeth comprising member A_3 are in the same plane as driving member A_2 , and those comprising member B_3 are in the same plane as driving member B_2 .

This six-tooth gear is interposed between the outside diameter of the driving member A_2B_2 , and the inside diameter of a stationary member A_1B_1 . The driving member A_2B_2 has two equally spaced tooth spaces in the same plane as members A_1 and A_3 and two equally spaced teeth just preceding these spaces, but in the same plane as members B_1 and B_3 . The root diameter of the inter-

vening gaps between the teeth is the same as that used in conventional gear practice.

The stationary member consists of a plate (or plates) in which there is a hole of such a diameter as to allow two teeth in the same plane as A_3 of the gear to pass when the third tooth in that plane is engaged by one of the tooth spaces in A_2 . At a single point in this inside circumference, however, there is a tooth space in A_1 , with a single tooth in B_1 just ahead of that tooth space. As in the driving plate, the tooth is the only projection into the area of rotation of the gear B_3 .

In operation, the stationary plate is positioned with the tooth space in A_1 at the top of the crank motion. During the dwell portion of the cycle, when the pin C is at the top position instead of in the bottom position as shown in the illustration, the gear is securely locked between the major diameter of the driving plate A_2 and the single tooth space in the stationary member A_1 .

When the driving member A_2B_2 has rotated one-half turn, the tooth in B_2 engages the tooth in gear B_3 that is opposite the tooth in A_3 engaged in the tooth space of the stationary member A_1 . At this point, one tooth of gear A_3 is

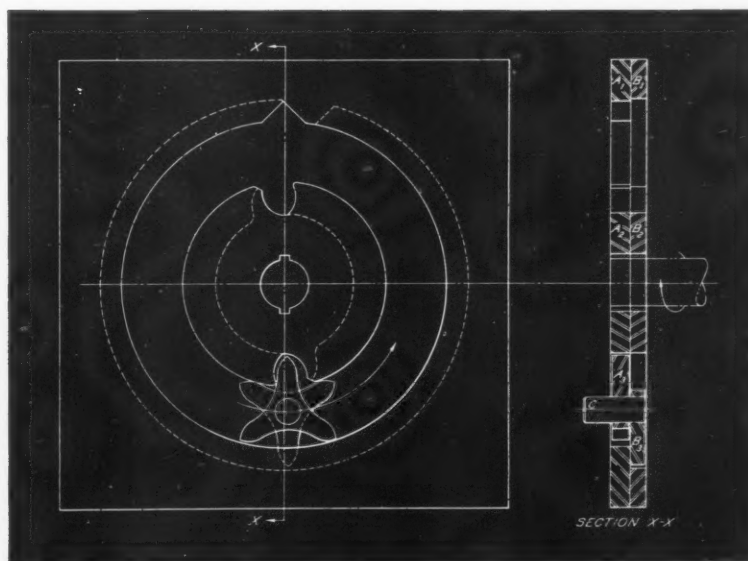


Diagram of a mechanism designed to produce an intermittent rotary motion

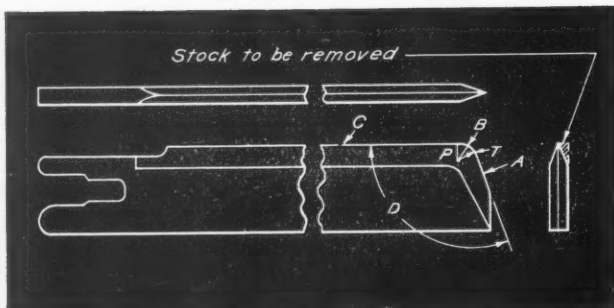


Fig. 1. One of the blades that are form-ground by means of the mechanism illustrated in Figs. 2 and 3

now free to enter the adjoining space in A_2 . The third tooth of A_3 is confined by the inside periphery of A_1 , and with one tooth of A_3 located in a tooth space in A_2 , the gear A_3B_3 carries the driven wrist-pin C around until a tooth-and-space cluster in A_1B_1 again arrests the motion.

Although the movement as shown provides a dwell of one-third of the total cycle time, a large number of variations are possible with this movement. The dwell time can be no more than one revolution of the driving member, but the arc of motion between dwells is limited only by the spacing of the tooth-and-space clusters in the

stationary member. The driven member can be made to move, within the limits of the spacing of the clusters, any percentage of the full circle, with dwell periods intervening, governed by the number and spacing of clusters in the driving member.

The shock of impact is somewhat reduced by the rolling action of the gear. The tooth space in A_2 was shaped to relocate the driving pressure at a point closer to the gear center.

Automatic and Continuous Feed for Form-Grinding Blades

By B. SPECTOR

The mechanism illustrated in Figs. 2 and 3 was developed to feed blades continuously to a straight type grinding wheel for grinding the edges to the form shown in Fig. 1. It will be seen that the desired edge contour consists of a short straight section A , a section with a radius B , and a long straight section C . The feeding device moves each blade under the grinding wheel in such a manner that section A travels

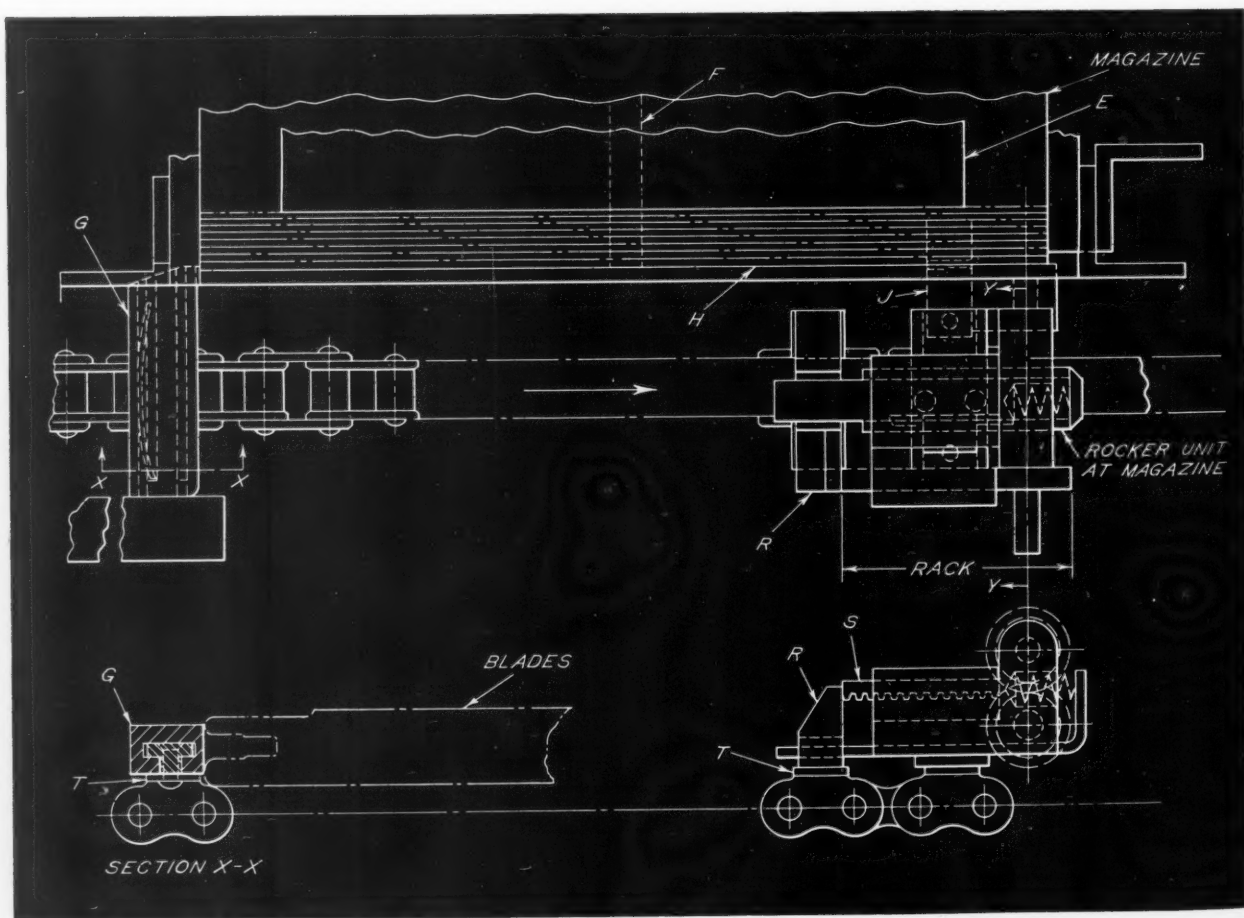


Fig. 2. Schematic diagram of a mechanism designed to feed blades continuously from a magazine to a grinding wheel for form-grinding

horizontally until the pivot point *P* of the curved edge coincides with the rounded face of the wheel, at which time the feed mechanism dwells and the blade is rotated through angle *D*. Immediately after this movement, the blade is passed horizontally under the wheel for grinding edge *C*. Figs. 2 and 3 show the work in position for grinding the last section *C*.

In operation, a stack of about 200 blades is pushed from a magazine toward a feed chain by means of a slide *E* guided in a keyway *F*, Fig. 2. The chain is provided with cross-slides *G* at regular intervals. By means of these cross-slides, one blade at a time is removed from the magazine retaining wall *H* and moved in the direction of the chain travel (indicated by the arrow), toward the grinding wheel. During this operation, a gripper *J* is swung out of the way of the magazine by the action of a pin *K*, Fig. 3, which enters a cam track in a rocker unit, while a bar *L* releases gripper *J* to permit the spring *M* to exert a force that clamps the blade in position for grinding the first section *A*.

When this section has been ground and the blade has advanced the point of tangency *T* shown in the part drawing, Fig. 1, to the lead

edge of the wheel, a pivot on the rocker unit is engaged in a slot *N* in rocker *Q*. This stops the linear motion of the blade while a pusher *R*, Fig. 2, actuates a rack *S* to operate gears that rotate the rocker unit through angle *D*, Fig. 1. The gears (section *Y-Y*) are so proportioned that the feed rate is uniform through the grinding of sections *A*, *B*, and *C*. In this view, the wheel is rotating in a counter-clockwise direction. One of the chain attachments *T* is provided with a dog that rotates rocker *Q* at the end *U*, so that the pivot is released to continue its linear travel. When the blade is in the horizontal position again, another cross-slide *G*₂, Fig. 3, supports it and takes the grinding thrust.

Guides *V* on the machine base swing downward as the result of engagement with protruding parts on the chain. When these protrusions pass the guides, springs (not shown) return the guides to the position illustrated.

* * *

The Department of Defense has announced that Armed Forces Day will be observed this year on May 17.

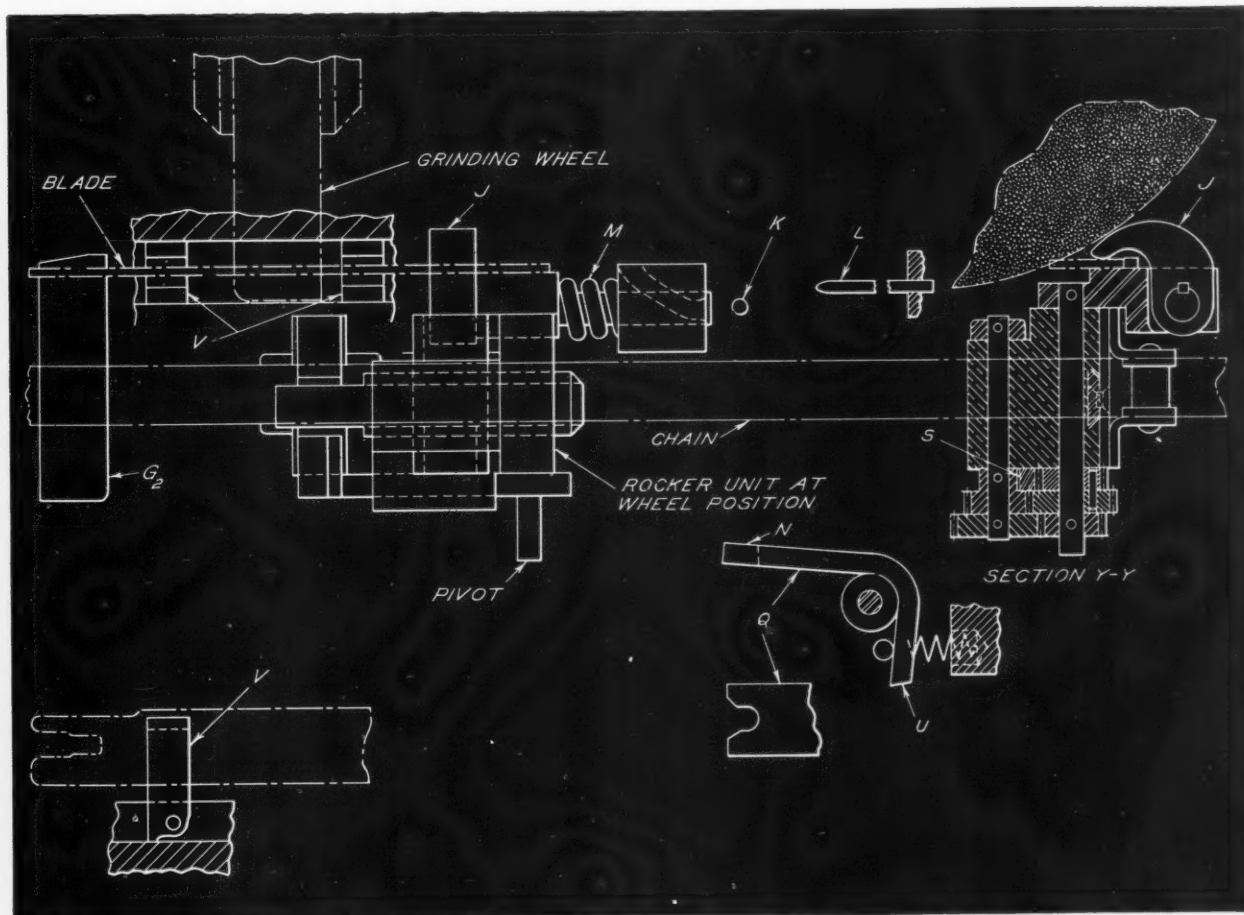


Fig. 3. Mechanism illustrated in Fig. 2, showing the blade in position for grinding the long straight section (C), Fig. 1

Machine Tool Electrification Forum

THE sixteenth annual Machine Tool Electrification Forum sponsored by the Westinghouse Electric Corporation, which was held in Buffalo, N. Y., on April 1 and 2, was attended by over three hundred engineers and executives. Technical papers presented at the conference dealt with electrical developments of special interest to the machine tool industry. The first day's session was held at the Hotel Statler, while the second session was held at the Buffalo motor plant of the company.

In a paper presented at the first day's session entitled "Machine Tool Control-Transformer Selection," Royce E. Johnson of the Barber-Colman Co., Rockford, Ill., pointed out that all of the requirements of control transformers except the volt-ampere rating could be obtained on the basis of specification requirements and good judgment.

Calculations for the determination of transformer capacity are of two general types—first, those made to see whether or not the transformer is large enough to deliver adequate voltage to a load; and second, those that show what the load will do to the transformer. Graphs that considerably simplified these calculations were shown.

W. O. Osbon, Research Laboratories, Westinghouse Electric Corporation of East Pittsburgh, Pa., presented a paper on the "Operating Characteristics of Driving Elements in Regulated Systems." This paper described common types of driving members used in feed-back control systems, including direct-current motors, two-phase alternating-current motors, hydraulic motors and cylinders, and eddy current and magnetic fluid clutches.

The characteristics of these devices and their associated power sources were compared in terms of their effect on feed-back control system performance. The paper also indicated how cost requirements affect the choice of the driving element, sometimes at a sacrifice of the desired operating characteristics.

T. A. Wetzel, supervisor of development, Kearney & Trecker Corporation, described a new type of milling machine in his paper entitled "A New Knee Type Contour Copy Milling Machine." Feed rates up to one hundred inches per minute can be obtained with this machine, and optical means are used to engage the guiding pattern. The work-piece produced is not a replica of the pattern employed, a male piece being produced from a female pattern, and vice versa.

Dr. L. P. Winsor, professor of electrical engineering, Rensselaer Polytechnic Institute, in his

paper "Power Supplies for Adjustable-Speed Drives," described rotating machines and electronic and dry plate rectifiers commonly used as power supplies for adjustable-speed drives. A comparison was made of the various types as regards speed range, speed regulation, torque characteristics, and cost.

A feature of the second day's program was a discussion of problems in building control panels, from the engineer's idea to the assembled panel on the machine, by a group comprised of C. D. Coffin, chairman, Euclid Tool Engineering Co.; B. T. Anderson, Sundstrand Machine Tool Co.; J. A. Danly, Danly Machine Specialties Co.; T. T. Fenn, Bryant Chucking Grinder Co.; and R. L. Inscho, Pratt & Whitney Division Niles-Bement-Pond Co.

P. G. DeHuff, metallurgical engineer with the Aviation Gas Turbine Engineering Division of Westinghouse Electric Corporation, described some of the problems encountered in the machining of titanium, titanium-base alloys, stainless steel, and Stellite turbine blades. Mr. DeHuff indicated that cooperation between the metallurgist and the machine tool builder is necessary for the solution of such problems, and outlined some of the measures that have already been applied to facilitate the machining of these high-temperature alloys.

A paper by William M. Pease, assistant professor of electrical engineering, Massachusetts Institute of Technology, described how electrical information-processing equipment and electric and hydraulic servo-mechanisms, when properly combined with a milling machine, facilitate the machining of complex parts, such as dies and forgings. Punched paper tape is used to replace the usual templates and cams for controlling the milling operations.

The operation of the saturable core reactor and self-saturated magnetic amplifier was described in a paper entitled "The Magnetic Amplifier—A Versatile Tool," R. W. Moore, manager of the development section, control engineering, Westinghouse Electric Corporation. Mr. Moore's analysis indicated the important function of the self-saturating circuit and demonstrated the great increase in power amplification obtained by its use.

D. L. Pierce, manager of general-purpose control engineering, Westinghouse Electric Corporation, in a paper entitled "Application of Thermal Relays for Motor Protection," considered the effect of continuous and intermittent operation, as well as the ambient condition.

TOOL ENGINEERING

Ideas

Tools and Fixtures of Unusual Design and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Rethreading Attachment for Removing Burrs after Slotting Threaded Work

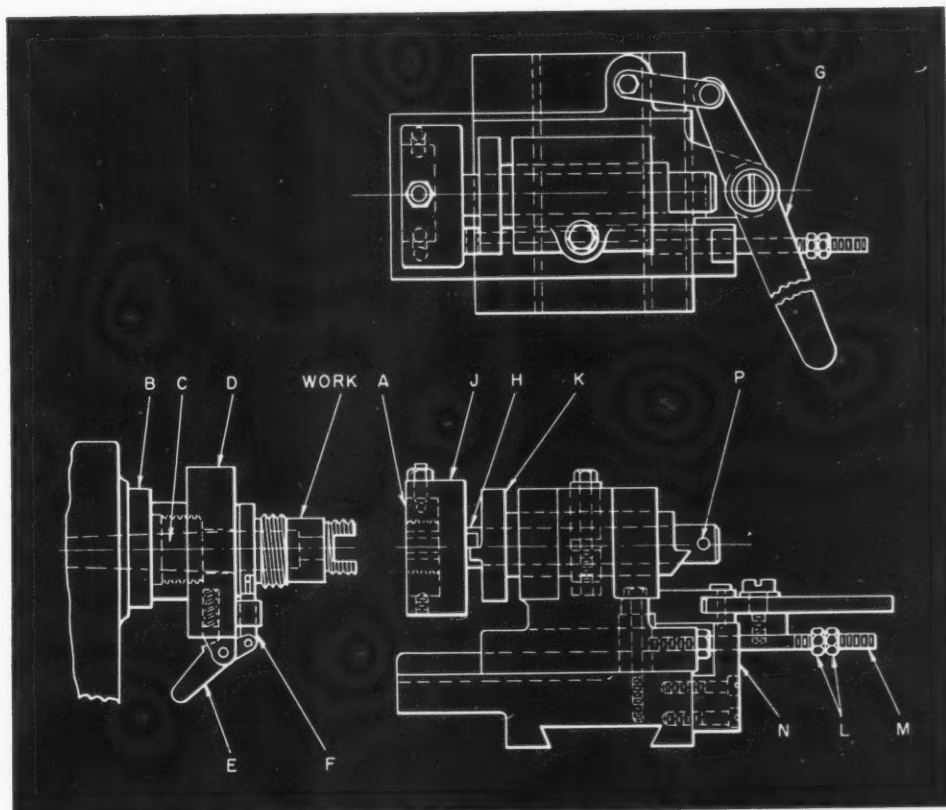
By B. P. FORTIN, Hartford, Conn.

The accompanying illustration shows an attachment designed for rethreading work in a lathe to remove burrs after a slotting operation. The attachment fits the cross-slide of the lathe, and slides in dovetailed gibs to carry the die-holder to the work.

One of the principal requirements in this design was that the threading die *A* have a sufficient number of lands to insure adequate support on the unslotted portion of the work as it revolves. For this purpose, the die is provided with eight lands. The lathe spindle, centering arbor, and work-holding fixture are designated *B*, *C*, and *D*, respectively, in the illustration.

In operation, the lever *E* is depressed to withdraw a locating and holding pin *F*, so that the work can be placed against the shoulder of the fixture. Then a hole in the work is aligned with this pin, which enters it to secure the work on the fixture. A handle *G* on the lathe attachment is now actuated to move the die into contact with the revolving work. As soon as the die engages the threaded portion of the work, it is automatically fed forward until the driving lugs *H* on the die-holder *J* disengage from the lugs on an adjustable reversing sleeve *K*. At this point in the cycle, the die will, of course, revolve.

The disengagement of the driving lugs is accomplished by contact of adjustable stop-nuts *L* on stop-rod *M* with a pad *N* as the attachment moves forward. The location of these nuts on the rod regulates the point at which the die is released. When this point has been reached, a



Lathe attachment simplifies a rethreading operation performed to remove burrs from work that is slotted after being threaded.

shoulder on the shank of the reversing sleeve *K* engages a pin *P* in the die-holder shank, thus disengaging the die from the work. At the same time, the lathe spindle is reversed. The lathe attachment is moved back to its original position by actuating handle *G*.

Multiple Measuring Blocks Facilitate Set-Up and Inspection

By WALTER M. THORYK, Mayfield Heights, Ohio

With a set of the simple and inexpensive multiple measuring blocks such as illustrated, required sizes are always available, and the time necessary to set up machines or inspect work-pieces is reduced. Each of the four blocks seen in the foreground is 4 11/16 inches long by 1 inch wide, and their upper faces have twenty-five steps, 3/16 inch long, which vary in height by increments of 0.010 inch.

The block at the left has steps measuring 0.010 to 0.250 inch, inclusive, from the top of the steps to the bottom surface of the block. Succeeding blocks have steps from 0.260 to 0.500, 0.510 to 0.750, and 0.760 to 1.000 inch high. Each step has its height dimension etched into the surface of the metal for easy identification. Parallel height bars, such as the one seen in the background, varying in size by 1-inch increments can be provided to increase the range of the measuring blocks.

In addition to this so-called "Centipede" height gage, a similar "Decimal Equivalents" height gage has been made. The latter consists of two stepped blocks, 6 inches long by 1 inch wide. Each block has thirty-two steps, 3/16

inch long, the height of which varies by increments of 0.0156 inch. The steps in one block range from 1/64 to 1/2 inch high, inclusive, and those in the other, from 33/64 to 1 inch. The top surface of the steps is ground parallel with the bottom surface of the blocks.

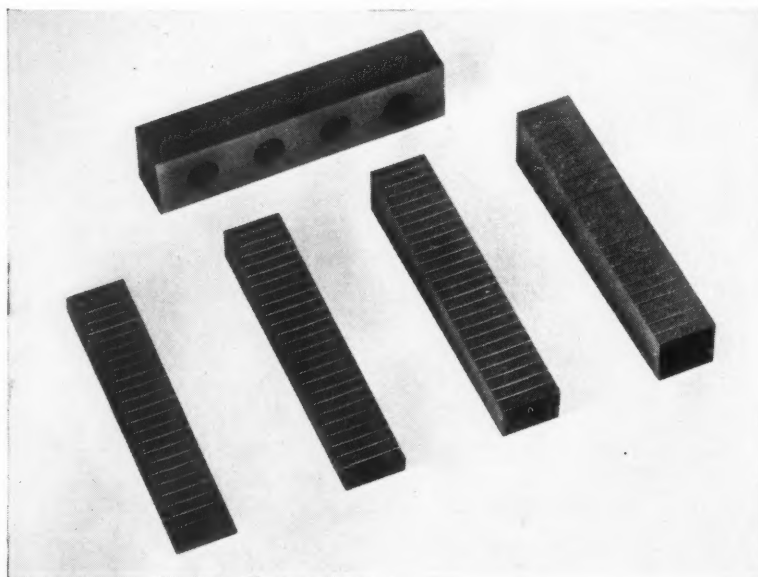
Fixture for Multiple Form-Grinding with Crush-Dressed Wheels

By ROBERT W. NEWTON, Poughkeepsie, N. Y.

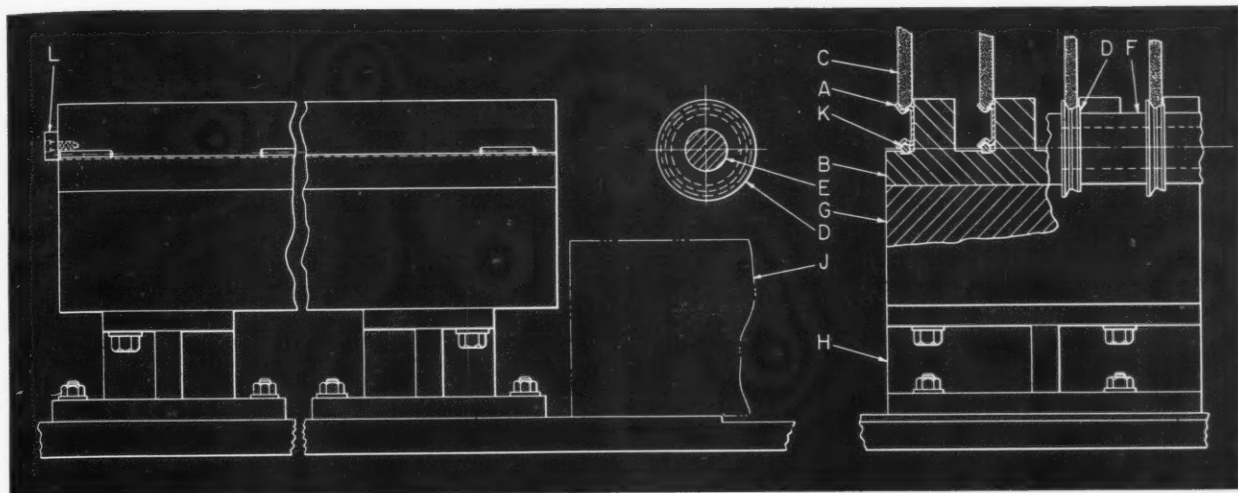
The fixture illustrated provides a good example of multiple form-grinding, using the crushing method of wheel dressing. The work-pieces have V-tracks *A* in them, one on each side, that require to be ground straight and accurate. When formed by rolling, the V-tracks were not accurate enough to meet specifications. The parts are required in different lengths. For this reason, the magnetic chuck *B* was designed to accommodate any length piece. While only four of the longest parts can be ground at a time, the shortest parts, which have the highest production rate, can be ground twelve at a time.

To provide a flat surface for location on the magnetic chucks *B*, the back faces of the work-pieces are ground on a Blanchard grinder, using a fixture to provide accurate location from the V-tracks. The machine used to grind the V-tracks is a large Thompson four-wheel form grinder, especially designed for crush-form dressing of the grinding wheels.

After trying many different grinding wheels *C*, the best results were obtained with a vitrified-bond, aluminum-oxide wheel of 180 grain size, J hardness, and No. 8 structure. These wheels



Set of four blocks seen in the foreground provides a simple and inexpensive height gage. Each block has twenty-five steps that vary in height by 0.010-inch increments. The range of the measuring blocks can be increased by the use of the parallel height bar shown in the background.



Fixture employed for grinding V-tracks in from four to twelve parts at a time. Four grinding wheels (C) are used, the wheels being dressed to the required form by crusher rolls (D).

give a very good finish and a sharp form, in addition to holding up well under the pressure of many dressings with the crusher rolls.

The hardened crusher rolls *D* are made in sets of four, from either Latrobe BR-4 steel or an 18-4-1 high-speed steel. From 1200 to 1600 parts can be ground before the rolls need to be re-ground. When this becomes necessary, the crusher rolls are sent to the tool-rooms in sets of four. A template to aid in diamond-dressing the wheels was provided. The crusher rolls are made more than 3 inches in diameter, so as to allow a rigid 1 1/2-inch diameter crusher-roll spindle *E* to be used. The four rolls are accurately located on the spindle by three spacers *F*.

The powerful magnetic chuck and the auxiliary plate of the fixture *G* are mounted on a welded filler block *H* to bring the center of the vees in the sides of the work-pieces in line with the crusher rolls mounted on base *J*. The work-pieces are placed against the vertical faces of the magnetic chuck, with their vees located on pins *K*, which rest in grooves in the chuck. The pins for grinding the vees in the opposite sides of the work-pieces have to be of a larger diameter to compensate for the stock removed in grinding the first vees. Stop-blocks *L* are provided at the end of the four magnetic faces of the chuck to aid in positioning the work-pieces firmly.

In operation, the magnetic chuck is energized and four short work-pieces are placed against the vertical faces of the chuck, being located on the pins and against the stops at the end of the chuck. Then four more parts are placed in position, locating them against the ends of the parts in the first row. After all of the pieces are in position, they are rapped with a mallet to insure that they are fully seated against the chuck faces and stops and on the locating pins.

Next the machine table is moved to the left until the crusher rolls are under the grinding wheels. Then the crusher rolls are fed to depth and the grinding wheels are rotated about 2 1/2 revolutions. When the grinding wheels have been formed to full depth, the machine is set for the full depth of cut required, which varies from 0.015 to 0.020 inch.

The table of the machine is now fed slowly—about 4 1/2 feet per minute—to prevent the vees in the work-pieces from being bowed. At the end of the cut, the table is lowered, the machine stopped, and the magnet current shut off. Then the parts are removed and cleaned of oil, and the chuck faces are also cleaned. The pins, too, are removed and cleaned, and the other set of larger diameter pins is placed on the chuck.

Next, the parts are again positioned on the chuck with the ground vees located on the pins, for grinding the other side. After the wheels have been crush-dressed again, the grinding of the parts is completed. It was found that less wear was produced on the crusher rolls if the wheels were dressed slightly after each pass.

Slitting Die of Sectional Construction

By FEDERICO STRASSER, Santiago, Chile

In sharpening slitting dies by grinding the working surfaces, the clearance between the punch and die sections is increased, thereby altering the results produced. The illustration shows a double slitting die, with both die and punch members of sectional construction. This design solved the problem of sharpening without changing the punch and die clearances.

The advantages gained by the adoption of a sectional design include quick, easy, and accurate machining, simplified hardening, grinding, and regrinding of working surfaces without altering dimensions or clearances, and easy, cheap replacement of parts in case of damage.

The die proper is made from four rectangular pieces of hardened tool steel. The central pieces are screwed and doweled to the die-shoe, and serve to determine the exact distance between the slitting lines. They also support pins for locating the work-pieces. The central blocks are not subjected to wear. The two lateral steel pieces have no holes in them, and four working sides may be used before they need regrinding. After regrinding, these sections are mounted so that they are clamped against the central blocks, thus maintaining the same original distance between the slitting lines. The whole set of steel blocks is held together by a strong frame and screws of adequate size.

The punch assembly is made up of two sections, separated by a shim, and is mounted in the

rectangular opening of the punch-holder. The latter also serves as a depth stop because the difference between the length of the punch and the height of the punch-holder corresponds with the distance the punch enters the work.

The punch sections provide two working surfaces before they need regrinding. After regrinding, the shim is replaced by one that is thicker by the exact amount ground away from the punches, so that the distance between the slits is not altered.

* * *

Mammoth Presses Developed for Air Force Heavy Press Program

Before long the heaviest forging press working at present in this country—having a capacity of 18,000 tons—will be dwarfed by one of 35,000 tons and another of 50,000 tons capacity. The Loewy Construction Co., Inc., a subsidiary of Hydropress, Inc., New York, is supplying the new forging presses, as well as six extrusion presses and the required hydraulic power plants, for the heavy press program of the U. S. Air Force.

The forging presses will be installed at the Wyman-Gordon Co., Worcester, Mass. Of the six extrusion presses, a 20,000-ton press is going into Alcoa's Lafayette, Ind., plant, and a 12,000-ton press is earmarked for the Caldwell, N. J., plant of Curtiss-Wright. The four others, all of 8000 tons capacity, are to be distributed as follows—two to the Kaiser Aluminum & Chemical Corporation, Halethorpe, Md., one to the Phoenix, Ariz., plant of the Reynolds Metals Co., and one to the Harvey Machine Co., Inc., Torrance, Calif.

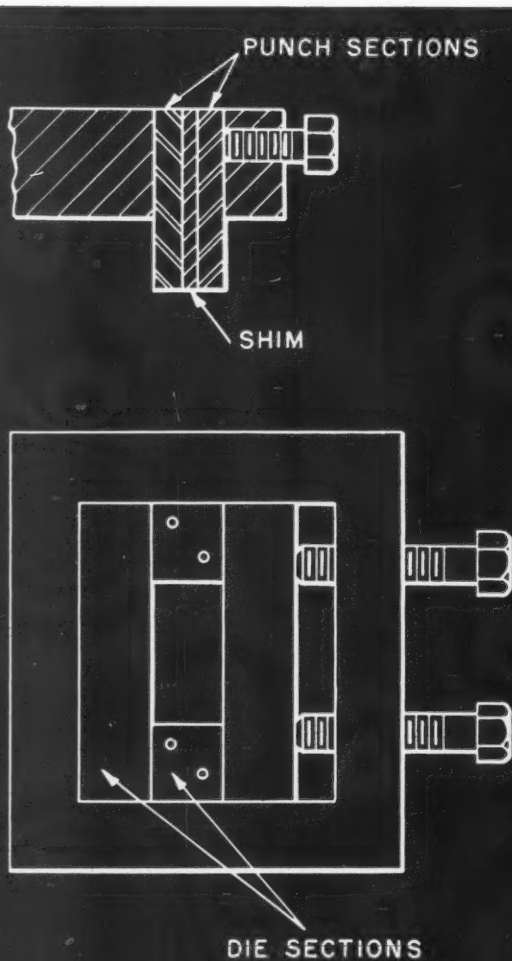
* * *

JIC Hydraulic Symbol Kit Available

Of interest to hydraulic engineers, designers of hydraulic circuits, and users of industrial hydraulic equipment is a novel kit being offered, free of charge, by the Denison Engineering Co., Columbus, Ohio. The kit is made up of two units—a plastic drawing template containing basic elements of all Joint Industry Conference hydraulic symbols, and a 32-page reference booklet in which all the examples of circuit components are represented by these symbols. Those desiring a kit can obtain one by writing Denison on their business letterhead, stating their title.

* * *

There are 62,200,000 drivers of motor vehicles registered in the United States.



Slitting die and punch of sectional construction, which simplifies resharping and enables correct clearance between the cutting members to be maintained

Sources of Lathe Vibration Located Electronically

VIBRATION-AMPLITUDE tests of completed machines, in addition to the balancing of individual components, have long been a part of the inspection given every lathe built by the Monarch Machine Tool Co., Sidney, Ohio. Until recently, however, the detection and elimination of vibration in the finished machines have depended on the skill of a handful of men developed through years of experience in doing this sort of work.

Now the concern employs an electronic device developed by the Lion Mfg. Co. of Columbus, Ohio, which combines in a single portable instrument all the equipment needed to pick up and isolate vibrations causing unbalance in a newly assembled lathe. With this device, termed a vibration discriminator, it is possible to pinpoint the sources of vibration, and by eliminating one after the other, to reach the desired degree of balance in a fraction of the time previously required.

As shown in the illustration, the instrument consists of three pieces of equipment. There is a compact portable case, which contains electronic tubes, transformers, and circuits, and two meters used to measure vibration in terms of frequency and amplitude. Also included are a reflector type stroboscopic lamp and a self-generating seismic-mounted, velocity type pick-up with a special filtering prod.

Several successive checks are made to eliminate the possibility of vibration developing from any combination of accessories with which the lathe is equipped. Operation of the vibration discriminator in making these tests is simple. With the driving motor of the lathe running, the pick-up may be rested upon, fastened to, or prodded against the particular part under observation. The pick-up may be placed vertically or horizontally on a component, depending on the direction of greatest vibration. The slender metal prod with which it is equipped enables contact to be made with surfaces that are almost inaccessible. The plane of greatest vibration and its magnitude are readily determined.

A low-pass filter with which the pick-up is equipped filters out the high frequencies caused by electrical pulsations, rough bearings, gears, etc. This makes it possible to segregate in a minimum of time the vibration caused by any out-of-balance condition. Vibrations in the ma-

chine are transmitted by means of the pick-up unit to the electronic circuits. These circuits perform several functions: (1) They keep the stroboscopic lamp firing in exact synchronism with the vibration sensed by the pick-up; (2) they give a reading on an amplitude meter of the peak-to-peak inches of linear displacement; and (3) they register on a frequency meter the speed or rate of occurrence of the individual vibration.

The angular position of unbalance in a part being checked is determined from the "phase angle," which is obtained when the part is, in effect, made to stand still through the optical illusion created by the intermittent flashing of the stroboscopic lamp. Having thus visually determined which part is causing the greatest vibration, that part can be replaced (as in the case of a belt) or balanced (as in the case of a sheave) and further checks made for the smaller sources of vibration. These are progressively eliminated. With the exception of belts, which generally have to be changed to eliminate vibration difficulties attributable to them, it is usually possible to correct an unbalance in components right on the lathe.

The exact angular position of the unbalance force will vary somewhat with the over-all mass, the manner in which the part is mounted, and the amount of unbalance. However, for all lathe



In making a vibration test, the pick-up of the vibration discriminator is mounted on or placed against the component under observation.

parts of the same mass and dimensions, similarly mounted, it has been the experience of the company that the angular force will be recorded in essentially the same angular moment after the "critical" speed of operation has been exceeded. All test runs are made at the same speed.

To determine this angular moment for a given lathe part, the procedure is to create a known unbalance by the addition to the part of a known weight. A trial run will then establish the approximate angle of unbalance, and the amplitude reading will record the displacement resulting from this known weight of unbalance. Having determined the approximate angular location from the stroboscopic lamp and the force required to produce the recorded amplitude, the permanent physical corrections are made by adding or removing weight at the proper point. Successive trial runs permit refinement of the degree of balance to any required extent.

* * *

Lincoln Incentive System Vindicated in Tax Court

After ten years of litigation, representing one of the longest tax cases on record, the United States Tax Court has completely upheld the incentive system of the Lincoln Electric Co., Cleveland, Ohio. The importance to industry generally of this decision is indicated by the opinion of the Court, which points out the effectiveness of incentive payments in increasing productivity and reducing prices. According to charts produced as evidence in the case, Lincoln's productivity per worker has increased at an average rate of 15.3 per cent per year during the last eighteen years, and prices have been reduced by about 50 per cent.

The case was started in 1942, when the Commissioner of Internal Revenue questioned the company's 1941 payment of some \$500,000 for employee annuities and \$1,000,000 for an employees' trust fund. Throughout the long litigation, the company argued that the results achieved by its incentive system establish that the payments are proper and reasonable.

* * *

A survey by General Motors Research Laboratories shows that at a 40-mile-an-hour cruising speed, the average fuel economy of twenty-nine different makes of automobiles has increased 30 per cent from 1930 to 1950. In 1930, the average was 15 miles per gallon of gasoline, while in 1950 the average was a little less than 20 miles per gallon.

Nice Ball Bearing Co. Celebrates Fiftieth Anniversary

The year 1952 marks the golden anniversary of the Nice Ball Bearing Co., Nicetown, Philadelphia, Pa. The company, originally known as the Pressed Steel Mfg. Co., was founded in 1902 by William Nice, Jr. It was established in a location in Philadelphia that had been part of a land grant awarded by William Penn to the founder's great grandfather.

The concern, which later changed its name to the Nice Ball Bearing Co., has been at its present location, 30th and Huntington Park Ave., in Nicetown, since 1916. From 1910 until his death in 1943, Budd G. Nice, son of the founder, was president. Since June, 1950, the organization has been headed by George Carleton, Jr., who has contributed for over twenty years to the progress of the concern.

During the early years, the company pioneered in the development of ball bearings for use in automotive king-pin and clutch applications, and in the first World War, made substantial contributions to the war effort, specializing in the production of thrust bearings for military trucks and mobile mount bearings of several types. Continuing this development after the war, the firm became established in the automotive field as an important source of bearings for both original equipment and replacement purposes.

Then the company sought to expand the scope of its production, making large quantities of bearings for many diversified industrial applications. During World War II, the production of control pulley and airframe bearings for military aircraft became a specialty, while large quantities of other bearings were also being produced for military and essential civilian requirements. Following its policy of expansion and diversification, the concern today manufactures over a million ball bearings each month.

* * *

Employment Service for Engineering Students

The American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio, has inaugurated an employment service for engineering students during the summer months. This service is without cost to either the employer or the student who seeks practical experience and income while on vacation. Approximately 200 concerns have specified a total of 1858 openings for engineering students, and these are listed in a printed leaflet, arranged geographically. The leaflet is being distributed by the Society to those interested.

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester and Silver
Sales Management Engineers
New York and Philadelphia

Are We Working on Projects?

THIS idea comes from an engineer selling metal-working equipment. He says: "For most of us, life being what it is, there is never time to do what we should. My greatest tendency is to think and work in terms of trips, interviews, sales arguments, reports, and records—all as specific things to do. I get like the commodity salesman with so many calls to make every day. For my part, to get further, I must concentrate on a few outstanding problems. To me, these are projects."

Another sales engineer expresses the same idea in this way: "In my work, I have to train myself constantly to focus on the broader and bigger things to do. It's easy to get near-sighted. Daily pressure makes me that way."

Just stop long enough to consider the merits of these remarks. Both salesmen are telling us that, to advance in our jobs, we should have projects of capital importance—beyond the daily task. Consider the forward-stepping sales engineers. Don't we find that, in addition to handling their daily affairs efficiently, they lay out big things to do? They select projects—the most important things to work on. Some of these projects are:

1. Concentrate on active or "key" prospects. Many of us right now may have more than one such prospect. But our great tendency is to scatter our efforts in too many directions. Choose wisely where to direct effort, and disregard, if necessary, those prospects of lesser importance. If we are after a water supply, we carefully choose the spot, then drill, and drill deep.

2. Make a systematic analysis of all the applications for our equipment. When I asked one salesman of buffing and polishing equipment how it was used, he answered, "Why, in all sorts of ways in finishing operations."

Questioning another salesman of plastic molding equipment, his answer showed me that he

considered the applications for his machines as a definite project. "Look," he said, "here is a list of applications I have discovered so far. Every few days I add one more. My plan is to assemble an exhaustive list of applications." "To what purpose?" I asked. "Why don't you see?" he replied. "With all the applications set down, I can lay out my sales program, know where to concentrate, and spend my time where there is most future business for me."

3. Develop yourself as an authority in solving some major problem that is common to your own equipment and to industry in general.

One salesman of electric welding equipment who realized the importance of this aim, said: "Though my objective is to become expert in handling each active job and sell more welding equipment, it is greater than that. I want to become a top light in the knowledge of welding."

Another sales engineer of boring and drilling equipment remarked: "Take the art of drill sharpening and pointing. I know a lot about it. But I have never taken the time to figure out and collect all the facts involved, so that I really would become a master in that art. This is a project I am going to work on now."

Still another sales engineer selling materials-handling equipment made an exhaustive study of the manufacture of foam rubber and its processing into salable items. This, for him, was an outstanding project. He finally did an extremely thorough job. From his ideas, new methods were employed and lower cost of production resulted. He became the country's outstanding authority on the subject and a vice-president of his company. Prospects now seek his help all over the country, and large equipment orders have resulted.

How far we step forward in selling industrial equipment depends on how clever we are in choosing certain basic projects to work on.

LATEST DEVELOPMENTS IN

Shop

Cross Special Machines for Processing Intake and Exhaust Manifolds for Automobile Engines

The processing of intake and exhaust manifolds for automobile engines can be accomplished at high production rates on special machines recently announced by The Cross Company, Detroit 7, Mich. Intake manifolds are produced on the pair of machines shown in Figs. 1 and 2, while exhaust manifolds are produced on the machine illustrated in Fig. 3.

The first operation on the intake manifolds, which is performed on the machine shown in Fig. 2, consists of milling the angular mounting pads and drilling the mounting holes. The second oper-

ation, accomplished on the machine illustrated in Fig. 1, includes milling the choke pad, carburetor pad, and water-pipe connection; boring the water hole and carburetor holes; and drilling, chamfering, reaming, and tapping all other holes. Production is at the rate of fifty pieces per hour.

The machine shown in Fig. 2 is of the dial type utilizing the Cross heavy-duty index-table, which is designed to index heavy loads accurately, with minimum "down" time. The second machine, Fig. 1, is a Transfer-matic, in which the work is automatically transferred

from station to station. Only one unskilled operator is required for each machine. The pre-set tools used are designed to reduce "down" time and minimize scrap by eliminating the use of trial and error methods in making set-ups. The Cross "Toolometer" automatically shuts off the machine when tools need changing. Automatic chip disposal is also a feature of these machines. Hydraulic and electrical construction conforms to the Joint Industry Conference standards.

The machine for processing exhaust manifolds, Fig. 3, performs

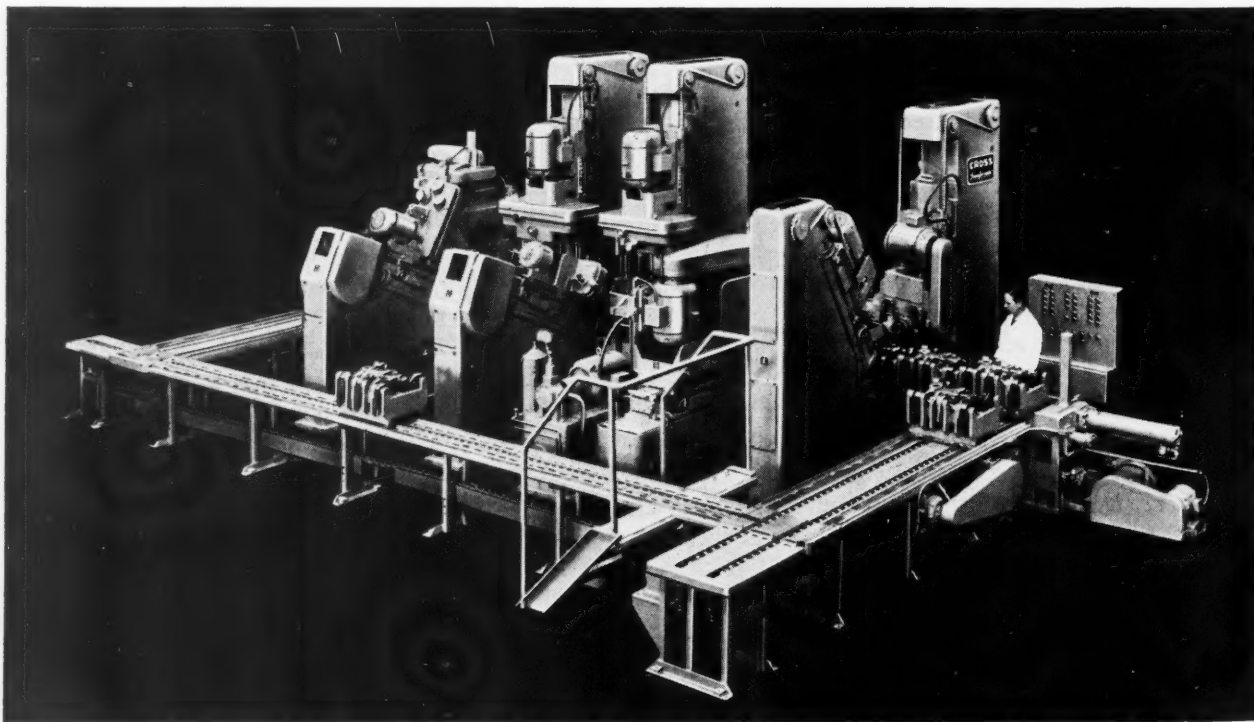


Fig. 1. Cross special "Transfer-matic" equipped for performing second operation on intake manifolds for automobile engines

Equipment

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on Market

Edited by FREEMAN C. DUSTON

milling, drilling, boring, chamfering, and tapping operations. This is a six-station dial type unit equipped with a heavy-duty index-table. It mills and drills the mounting face; and mills, bores, drills, and taps the tail pipe pad at the rate of 120 manifolds per hour. Right- and left-hand exhaust manifolds are machined without changing the set-up.

One of the stations is used for loading, two for milling, two for drilling and boring, and one for tapping. Pre-set tools are used on this machine also to reduce "down" time and minimize scrap losses during set-ups. Other features include power indexing; hydraulic feed for milling, drilling, and boring; individual lead-screw feed for tapping; and hardened and ground ways. The use of standard Cross sub-assemblies provides the flexibility necessary to allow for any future changes in part designs.

High-Speed and Carbon Steel Twist Drills Added to Butterfield Line

The Butterfield Division of the Union Twist Drill Co., Derby Line, Vt., has announced the addition of a complete line of high-speed and carbon steel twist drills to the Division's present line of taps, dies, and reamers. Besides the standard styles and types of twist drills, the new Butterfield line will include drills especially designed or styled for use on materials such as magnesium, aluminum, plastics, etc., as well as various types of drills for special operations on aircraft. The company will also carry in stock a line of extension, heavy-duty, and automotive series drills.

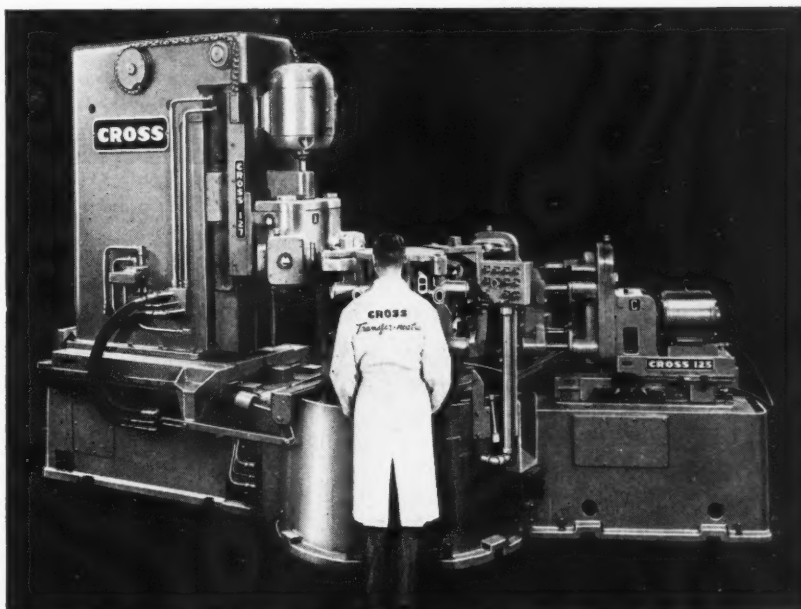
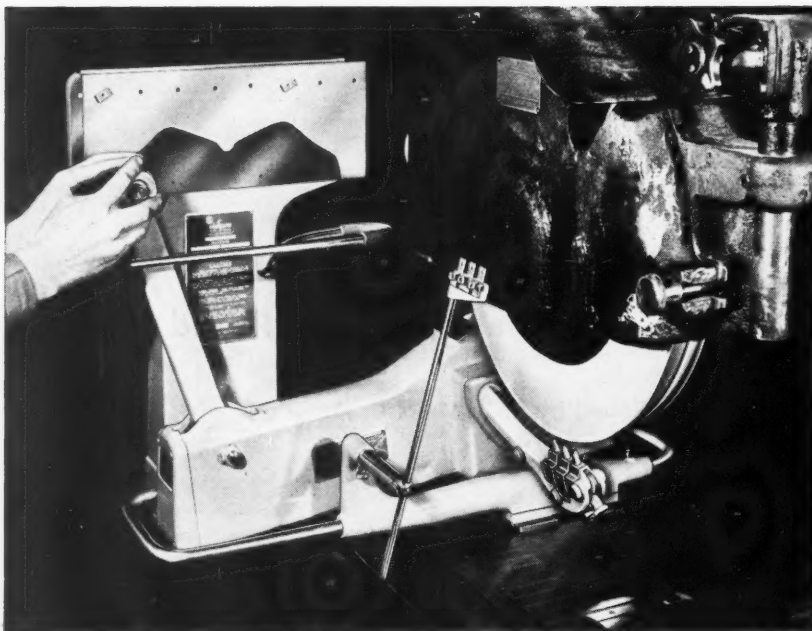


Fig. 2. Cross dial type machine for first operation on intake manifolds



Fig. 3. Cross six-station dial type machine for processing exhaust manifolds



Pratt & Whitney "Diaform" form-truing attachment for surface grinder wheels

P & W "Diaform" Form-Truing Attachment for Medium- and Heavy-Duty Surface Grinder Wheels

Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn., has developed a larger "Diaform" wheel-forming attachment, designed to simplify the form-truing of grinding wheels up to 20 inches in diameter, such as are used on medium- and heavy-

duty, horizontal-spindle surface grinders. This new Model 4 "Diaform" provides a quick, accurate method of truing a given form up to 3 inches wide and 1 inch deep in one setting.

The new unit is similar in design to the smaller "Diaform" de-

scribed in the August, 1949, number of *MACHINERY*, page 189. The basic design consists of a vertical pantograph with a 5 to 1 ratio template, which guides a truing diamond across the periphery of the grinding wheel.

The attachment is portable, weighing approximately 75 pounds, and is placed on the magnetic chuck or strapped to the table of the grinder. Three diamonds, mounted in tandem, are employed to true a new form on a wheel: one is for roughing, one for semi-finishing, and one for finish-truing. A worn finishing diamond is ordinarily used for semi-finish truing, thereby extending the accurate life of the finishing diamond. The diamonds are mounted on the diamond spindle of the "Diaform," and a centering gage is provided to center each one under the grinding wheel for its respective truing operation.

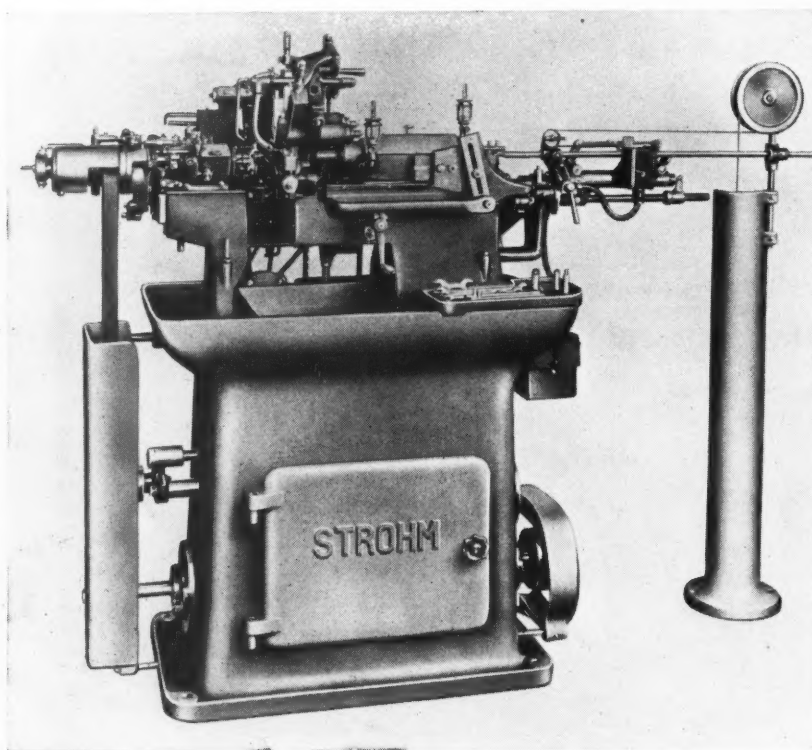
In order to permit the "Diaform" to be used efficiently on different makes of surface grinders, it is made in both right- and left-hand models. The right-hand model (4A) is usually furnished for use on machines with clockwise wheel rotation, and the left-hand model (4B) is employed on machines with counter-clockwise wheel rotation.

Strohm Automatic Screw Machine

Small screws, nuts, bolts, spindles, pinions, rivets and many other precision components for clocks, instruments, toys, and optical and electrical products can be produced to extremely close tolerances at high rates of production on the Strohm long turning automatic machine. This machine, which is built in West Germany, is being distributed in the United States by Kurt Orban Co., Inc., 205 E. 42nd St., New York 17, N. Y.

A wide speed range makes this machine suitable for high-volume production, the actual output depending on the permissible cutting speed for the metal being worked. At the same time, ease of set-up permits the machine to be used economically for short runs.

The machine handles thread lengths up to 1.378 inches and bore depths up to 1.575 inches. Accessory equipment permits turning tapers up to 4 inches long.



Strohm automatic screw machine introduced in U. S. by Kurt Orban Co.

Other available accessories include rapid power traverse; three-spindle drilling and threading attachment; slot-cutting attachment; and attachment for centering and counterboring.

Two models are available for handling different sizes of bar stock. Type M75 takes up to 0.276-inch round, 0.197-inch square, and 0.236-inch hexagonal stock. The M105 machine handles 0.394-inch round, 0.276-inch square, and 0.315-inch hexagonal stock.

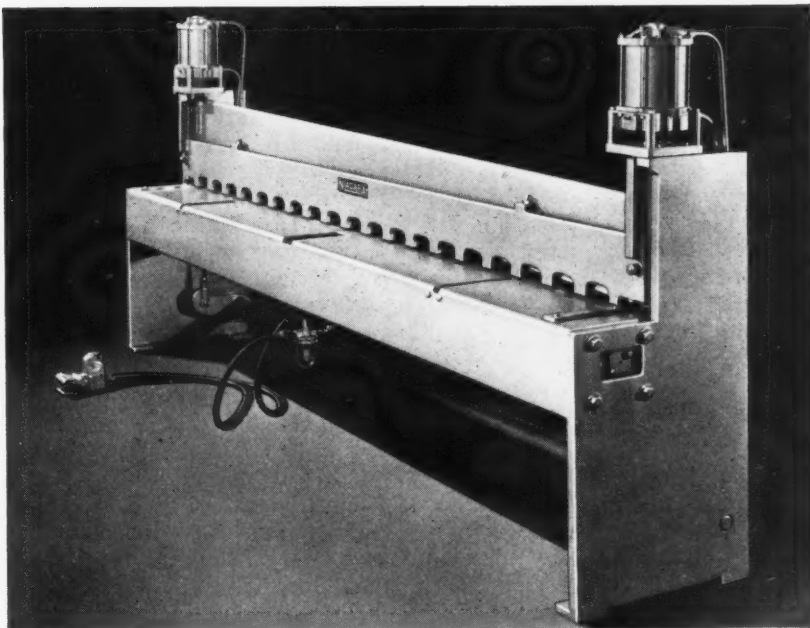
Rivett Internal-External Grinder

A small hole grinder that can be equipped for performing external work also is being placed on the market by Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass. This new Model 84 machine will grind holes from the smallest size up to 3 inches in diameter, with a maximum depth of 4 inches, the depth depending upon the diameter. It will grind external work up to 3 inches in diameter with a length of 4 inches.

The motor-driven wheel-heads for internal and external spindles are interchangeable. The correct internal spindle, with a removable arbor, chuck for mounted wheels, or a solid shaft, for speeds of 12,000 to 35,000 R.P.M., can be selected to suit the job. The work-head or table can be swiveled for taper grinding, and the micrometer table stop can be used to position work for accurate shoulder grinding with a fine hand feed.

Other features include lathe type spindle in work-head with draw-in collets or step chucks; quick acting lever collet and chuck closer; mechanical power table travel having infinite speed and stroke adjustment within a stroke length of 1/4 inch to 4 inches; hand table travel with both coarse and fine feeds to 0.001 inch; and hand in-feed for reductions in diameter of work with coarse adjustment to 0.001 inch and fine feed to 0.0001 inch.

The work-head, swiveling 90 degrees each side of center for bevel and taper grinding, has its spindle mounted on super-precision ball bearings, and has three speeds of 200, 400, and 600 R.P.M. The external wheel-head spindle is driven at 3450 R.P.M. by a built-in, dynamically balanced motor.



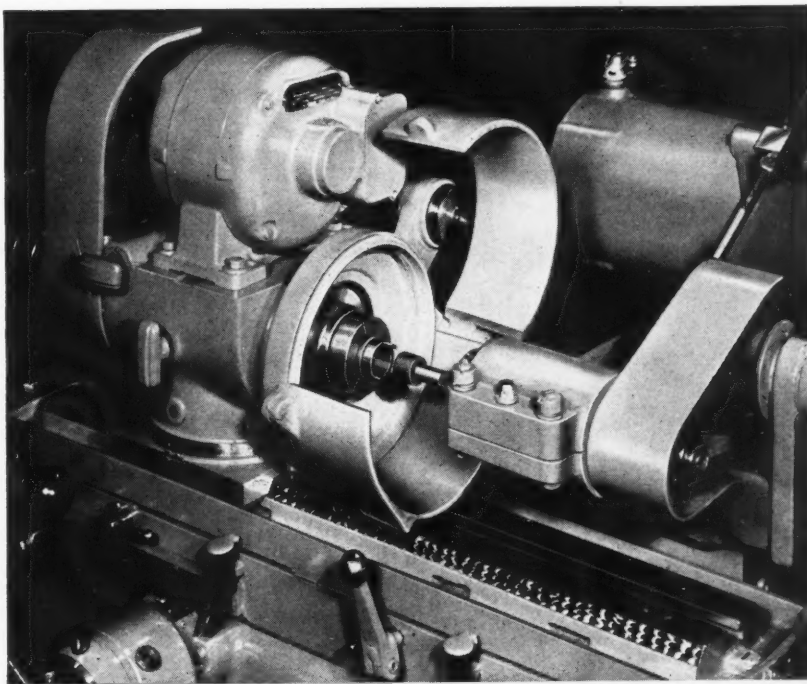
Air-power squaring shear announced by Niagara Machine & Tool Works

Niagara Air-Power Squaring Shears

A new "economy" line of air-power squaring shears designed for use in sheet-metal shops is announced by Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo 11, N. Y. The simplified construction of these shears is said to eliminate such parts as flywheels, gears, clutches, motors, and electrical controls, thus reducing initial cost and maintenance to a minimum. The machine can

be operated by air from any system found in the average shop with pressures of 70 or 80 pounds per square inch. For shops without air, a small air compressor and surge tank can be used.

Depressing the foot-valve automatically clamps the hold-down and lowers the cross-head to complete the cut. Releasing the foot-treadle instantly returns the hold-down and cross-head to the top



Internal-external grinder brought out by Rivett Lathe & Grinder, Inc.

position. A flexible air hose for the treadle permits the operator to trip the shear from any convenient location.

All main components are formed from welded steel plate designed to give maximum strength and rigidity, insuring long life and the maintenance of accurate straight-line cutting. The adjustable ways are made from laminated plastic to avoid scoring and cutting and

to hold wear to a minimum. The hold-down gives clear visibility of the cutting line.

A quick adjusting back gage is standard equipment on the smaller sizes, and a micrometer, ball-bearing, double-bracket parallel back gage with 1/128-inch graduations is used on the 8- and 10-foot lengths. All machines are provided with front brackets, a front gage-bar, and two side gages.

Italica Precision Boring Machine

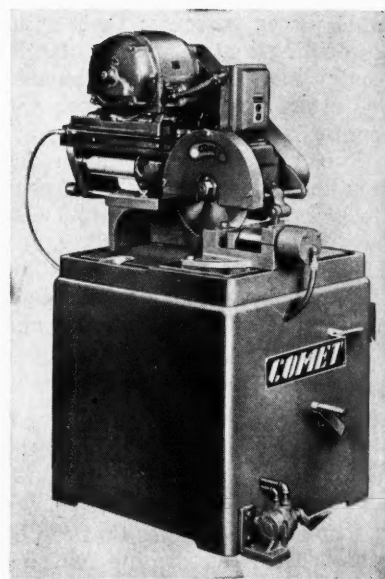
The Italica precision boring machine here illustrated is being introduced on the American market by the British Industries Corporation, International Machinery Division, 164 Duane St., New York 13, N. Y., Division I. This machine is manufactured in Italy by Rovai Jori. The head of the machine slides on a ground column, which is rigidly bolted to the bed, and has a scale with vernier and lens for measuring the vertical travel of the head.

Speed changes are accomplished through a series of honed alloy-steel gears immersed in an oil bath and mounted on roller bearings. The revolving table is of heavy steel, designed for minimum deflection under heavy loads. It

can be fed both horizontally and longitudinally, and revolves about a large graduated base. The chuck is supported by two bushings and an adjustable bronze taper bearing. Axial thrust is absorbed by thrust bearings.

Automatic Cut-Off Saw for Non-Ferrous Metals

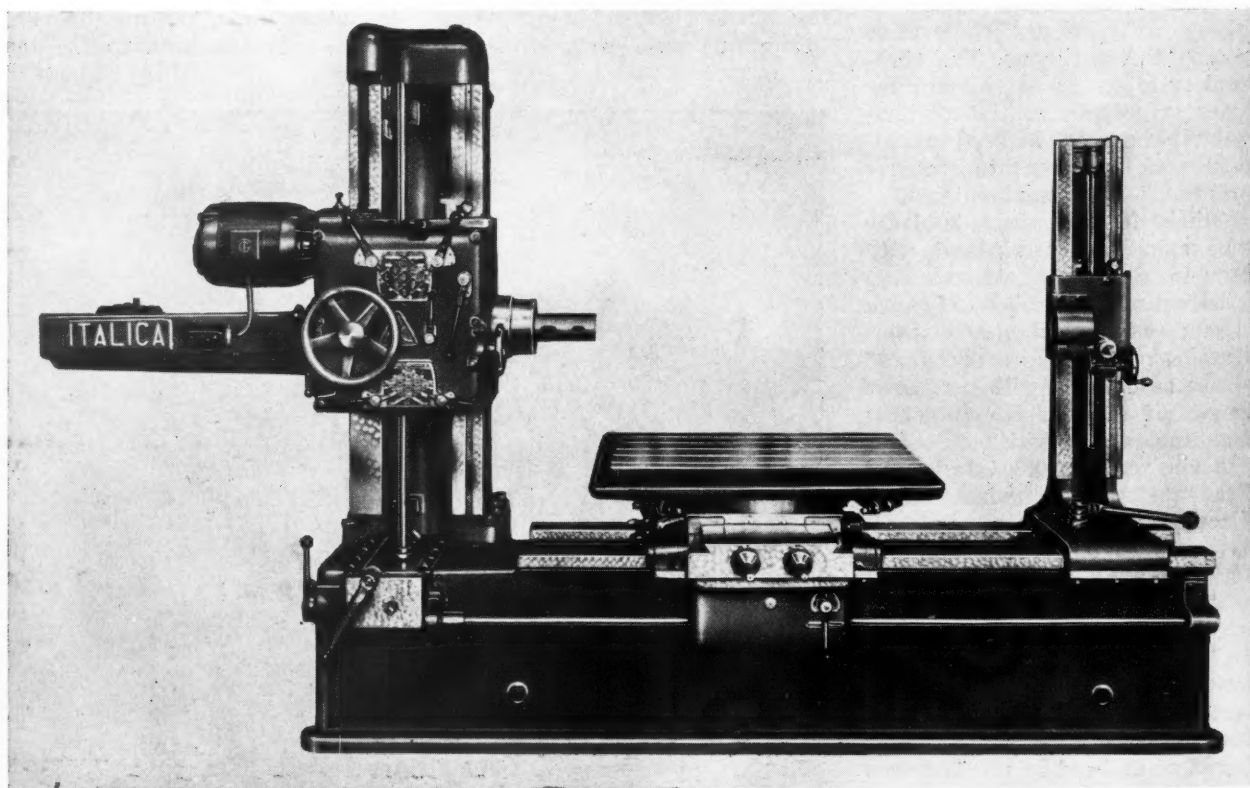
Non-ferrous metal bars and shapes in a wide range of sizes can be handled on a fully automatic cut-off saw known as the "Comet MH," which is being introduced by the Consolidated Machinery & Supply Co., 2031 Santa Fe Ave., Los Angeles 21, Calif. This machine uses a high-speed,



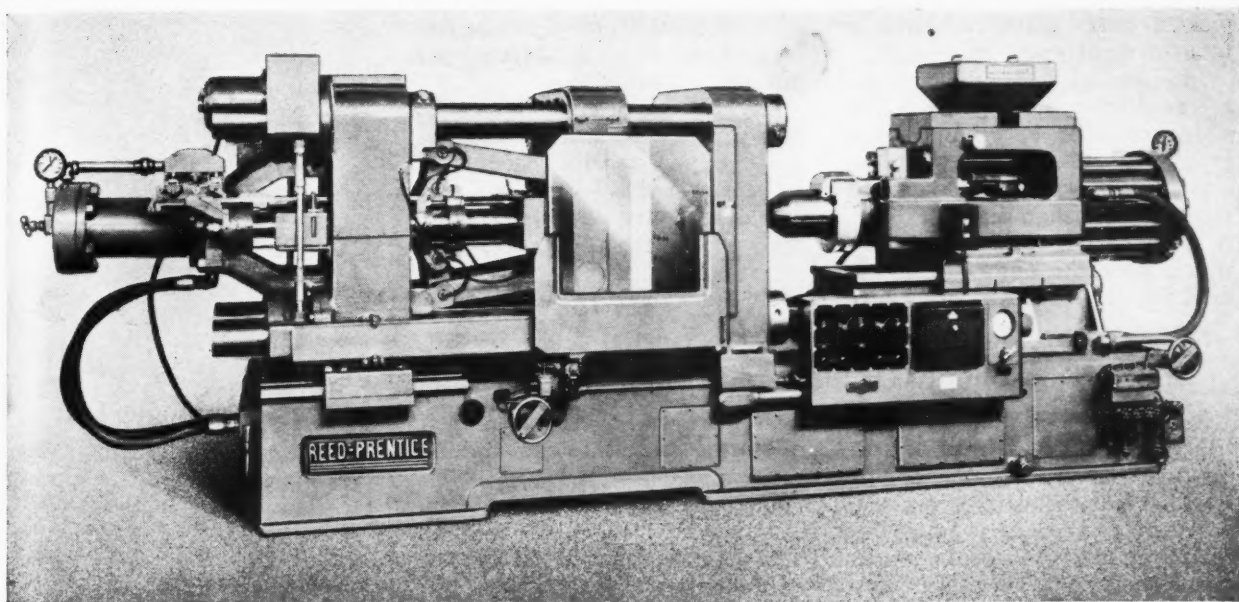
"Comet" automatic cut-off saw for non-ferrous metals

carbide-tipped, circular saw blade to cut off aluminum shapes up to 3 by 5 inches or aluminum bars up to 2 by 4 inches. The maximum capacity of the vise and 12-inch saw is 3 1/2 by 6 inches.

A foot control actuates the pneumatic-hydraulic feed ram. The machine has a 7 1/2-H.P. motor, and weighs 1300 pounds.



Italica precision boring machine introduced in this country by British Industries Corporation



Injection molding machine recently added to the line of the Reed-Prentice Corporation

Reed-Prentice Injection Molding Machine

The Reed-Prentice Corporation, 677 Cambridge St., Worcester 4, Mass., has brought out a new 16-ounce injection molding machine patterned after the larger 24-, 32-, and 60-ounce machines. This new machine, designated the 400T, will plasticize 110 pounds of thermoplastic material per hour. Die platens have been increased in size to 35 by 40 inches to accommodate larger molds and provide a casting area of 200 square inches.

The new mold closing mechanism of this machine develops 400 tons locking pressure. The stroke is a full 16 inches, and can be shortened for thin molds. A special prefill arrangement serves to speed up the machine cycle. Dry cycle time is given as 190 shots per hour. A central control panel automatically controls the movement of the die plate and plunger. The movable die plate slides on four 4 3/4-inch diameter tie-bars, additional support being provided by hardened steel ways.

A heating cylinder incorporating a copper core spreader is mounted on vertical ways to permit easy removal. Hydraulic and electrical interlocks are provided for the front safety door. Grouping of motor and hydraulic equipment at rear of machine facilitates maintenance. Steps and platform at rear protect the 30-H.P. main motor and provide ready access to hopper. The machine is 20 feet

6 inches long by 6 feet wide by 6 feet 9 inches high, and weighs 36,500 pounds.

Bardons & Oliver Cut-Off Lathes

Bardons & Oliver, Inc., 1135 W. 9th St., Cleveland 13, Ohio, has announced two new cut-off lathes.

The No. 33 machine has a capacity for cutting off pieces up to 3 inches in diameter (2 1/2-inch pipe), while the No. 34 machine will cut off pieces up to 4 inches in diameter (3 1/2-inch pipe).

Electric remote control permits automatic cut-off to any length. Spindle speeds range from 85 to 1100 R.P.M. with four quick changes. A pair of reversible



Bardons & Oliver automatic cut-off lathe

pick-off gears makes available a total of eight speed changes.

Independent hydraulic systems are used for operating the cut-off slides and collet chuck. A complete change in set-up for a different size and length of work can be made in less than one-half hour. A newly designed stock feed table which operates automatically is available for the machine. A pro-

duction chart shows pipe size and production rate in pieces per minute.

The average production on steel pipe nipple blanks up to 6 inches in length, cut off with roller cutter and chamfered at both ends on the outside diameter, ready for threading, ranges from 43 pieces per minute for 3/4-inch pipe to 9 per minute for 3 1/2-inch pipe.

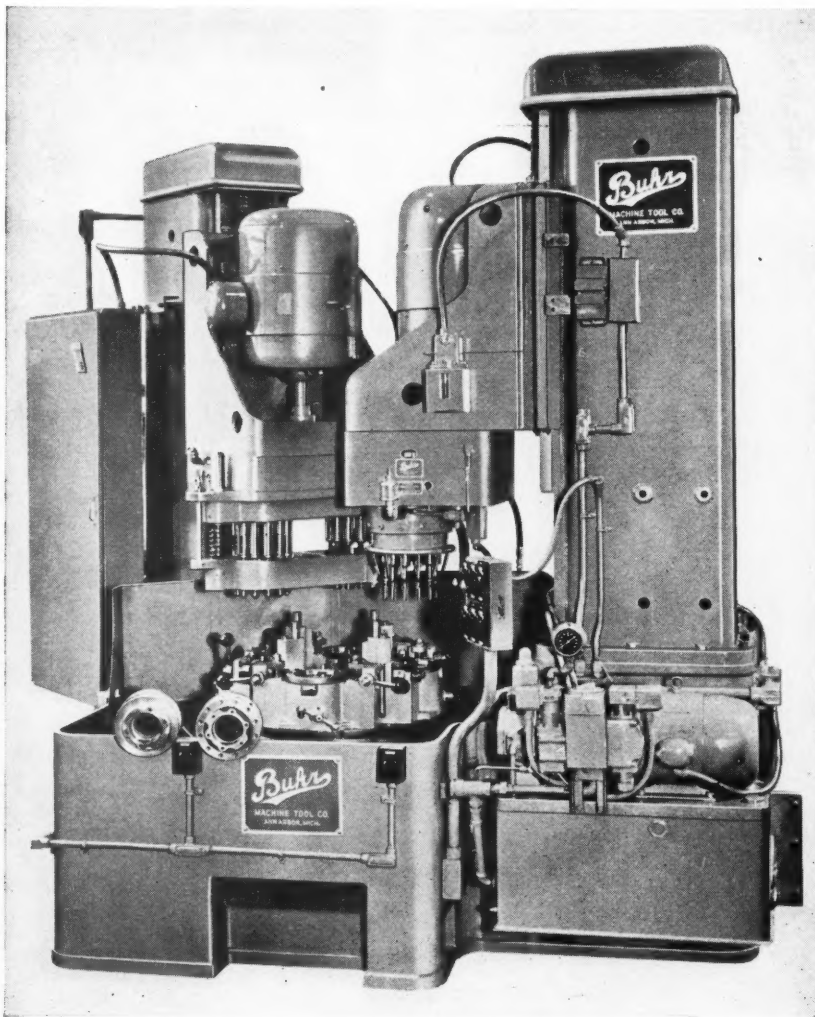
Buhr Two-Column Drilling and Tapping Machine

The Buhr Machine Tool Co., Ann Arbor, Mich., is manufacturing a special drilling and tapping machine for processing Army tank parts. This machine is of flexible design, enabling it to be easily converted for making other parts.

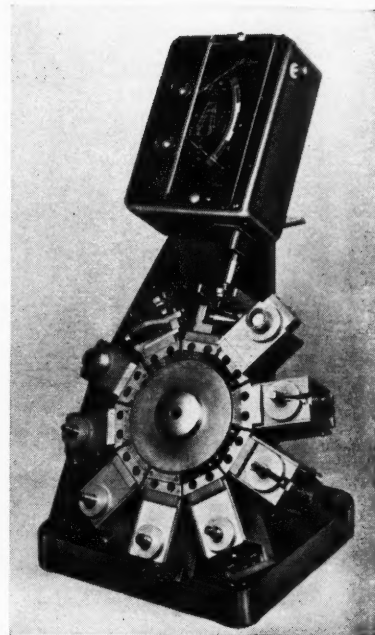
A special feature of the machine is the provision for drilling and tapping both sides of a part in the same fixture. This is accomplished by turning the part over after one side has been drilled and tapped. A single lever actuates two sets of

locators, lowering one set as it raises the other into the working position.

The machine drills, chamfers, and taps twelve 9/16-18 holes in each end of tank parts, two of which are shown at the lower left in the illustration. The tooling consists of a twenty-four-spindle drill head, a twelve-spindle individual lead-screw tapping head, and one four-station fixture, which is mounted on a four-position automatic index-table.



Buhr special machine for drilling and tapping tank parts



Comparator with turret for checking up to ten dimensions, introduced by the Cosa Corporation

Sigma Turret Type Mechanical Comparator

A turret type mechanical comparator manufactured by the Sigma Instrument Co., Letchworth, England, is being introduced in this country by the Cosa Corporation, 405 Lexington Ave., New York 17, N. Y. This comparator is designed for rapid checking on the production line to facilitate quality control of mass produced parts. It has only one measuring head, but a revolving turret, including adjustable fixtures, is provided for checking as many as ten dimensions of a work-piece. The maximum capacity of the fixtures is approximately 2 inches, and the checking is said to be accurate to four millionths of an inch.

Every station holds a fixture for checking one to ten dimensions. The contact tip of each fixture is adjustable, and is set so that, with a master component in position, the pointer registers zero. There are four standard fixtures for measuring internal and external diameters, external lengths, and internal depths. They are easily adapted for measuring work-pieces of different sizes.

A colored strip, fixed to the base of each fixture, refers to the dimension number on the component drawing, shown on the scale panel. The color of the strip points out

the tolerance zone for each dimension, which is indicated by contrasting colors on the arc of the scale panel. In this way, the limits of the different tolerances are clearly defined.

Vertical Hydraulic Surface Broaching Machine

A 15-ton vertical type hydraulic surface broaching machine having a stroke of 72 inches has been brought out by the American Broach & Machine Co., Ann Arbor, Mich. The machine is designed to conform with J.I.C. standards. A fixed hydraulic cylinder operates the work-slide, which is guided in adjustable hardened and ground ways. The new type ways, with a larger cross-section, are said to provide a more accurate and longer wearing slide.

The machine, designated the SB-72-15, is being supplied at present with a receding work-table and an automatic indexing unit for broaching ninety-five "Christmas Tree" slots in turbine wheels. It is also available with strokes of 90 and 120 inches.

Bliss Improved High-Speed Forging Presses

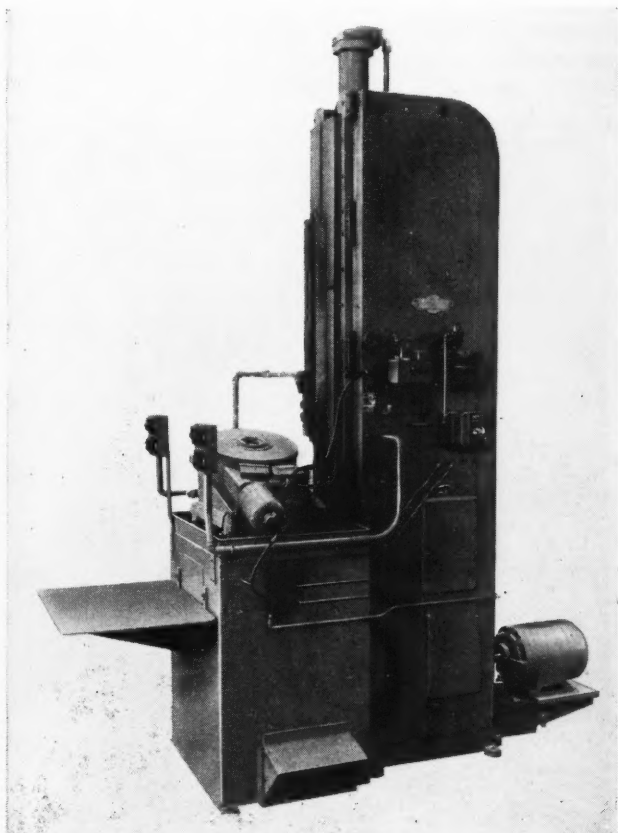
Development of an improved line of high-speed forging presses has just been announced by the E. W. Bliss Co., Canton, Ohio. Available in capacities ranging from 300 to 4000 tons, the new line features a heavy-duty air friction clutch and an air-release spring-set brake, both mounted on a full eccentric main shaft. The welded steel frame is designed with the main stress members located immediately adjacent to each side of the die seat. These stress members extend from the bottom of the bed to the top of the crown, and have unusually heavy sections, designed to keep elongation of the frame to a minimum when heavy loads are applied to the press.

A heavy plate, integral with the two front gibs, is bolted securely to the main stress carrying members. This plate, in addition to massive frame tying members in the rear of the press, opposes the inward deflection of the frame toward the slide ways. The front of the slide has long, continuous gib ways extending up into the crown to keep the dies in align-

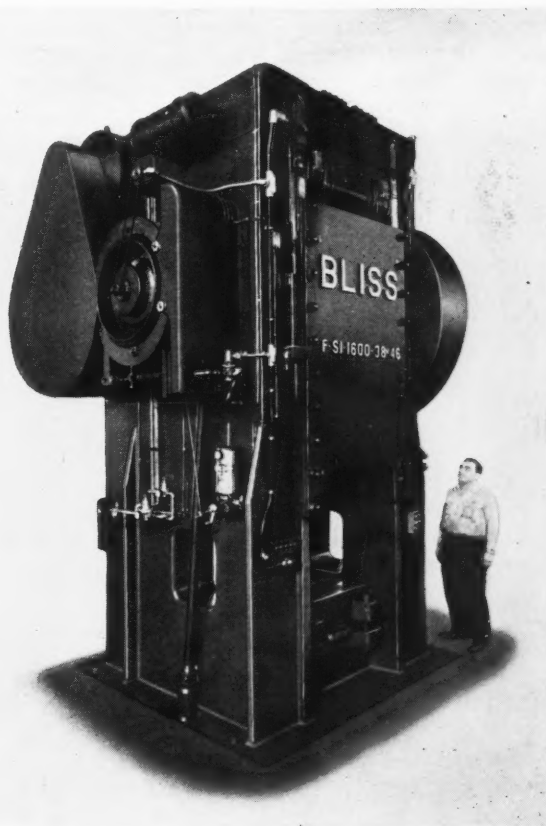
ment when off-center loads are applied.

Regular equipment furnished with the press includes a cam knock-out in the slide and a cam lift-out in the bed. The die seat is a self-contained unit, equipped with an easily operated wedge-adjusting mechanism. This mechanism is arranged so that the die seat can be bumped to the correct front-to-back alignment without disturbing the adjusting mechanism. Wedges can be inserted between the die seat and the frame uprights of the press for precision side-to-side alignment of the die seat.

To assist smooth operation at the relatively high speeds at which these presses operate, a "buffer" cylinder is installed in the crown, which assists the brake in stopping the heavy slide at the top position, and furnishes additional accelerating force when starting the slide, thus easing the load on the clutch. A load indicator, which registers the actual load on the press by measuring the elongation of the frame uprights, is furnished as standard equipment.



Hydraulic surface broaching machine built by American Broach & Machine Co.



Improved high-speed forging press recently announced by the E. W. Bliss Co.



Typical milling cutter of new "Universal" line announced by McCrosky Tool Corporation

McCrosky Milling Cutters

The McCrosky Tool Corporation, Meadville, Pa., has recently introduced a new "Universal" line of face milling and shell end milling cutters. The blades of the new cutters have round shanks. The round holes for the blades and the "Super-Jack" blade locking wedges overlap, and thus provide space for up to four blades per inch of cutter diameter.

A groove in the shank of each blade engages a tongue in the blade slot, assuring extremely accurate positioning of the blade shank. Thus the desired "hand"

and cutting angle is secured by simply inserting blades of proper design for the direction of rotation required and the metal being cut.

Any cutter body in the "Universal" line can be used for different cutting requirements, including right- or left-hand rotation; use of carbide or high-speed steel blades; and positive or negative rake angles. One body is supplied with different sets of blades to suit the kinds of work to be performed.

"Scallop-Edge" Abrasive Belt

A new "3M" brand "Scallop-Edge" abrasive belt designed for automatic precision grinding and finishing of jet turbine and compressor blades in a single operation has been announced by the Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn. In addition to solving one of the problems in jet-turbine production, the new belt is expected to find wide application in the manufacture of hand tools, cutlery, and other products requiring small-radius grinding and filleting such as previously was done by hand.

In use, the scallops of the belt curve around the edges of the contact wheel, as shown in the illus-

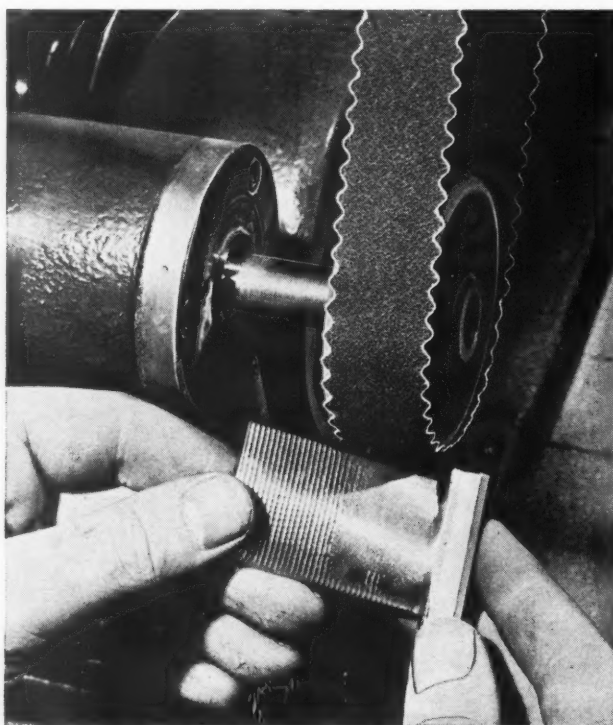
tration, allowing fillet areas to be polished on the edge contour of the wheel. Two separate steps were previously required to finish-grind each of the more than 2000 blades in a jet engine—foil grinding and root grinding. The new "Scallop-Edge" belt, used on an automatic grinder, is said to make it possible to produce a completely precision-finished turbine blade in a single operation.

The belt is employed on crowned, contoured, or rounded-edge wheels, or with shaped back-up supports, and can be used either by machine or by hand.

"Elec-Detec" Electronic Stethoscope for Locating Friction Noises

The "Elec-Detec" electronic stethoscope with a metal probe shown in the accompanying illustration has been designed to locate friction noises in bearings, pistons, gears, cams, clutches, pipe lines, valves, and other mechanisms. The metal probe serves as a microphone to localize the exact source of the noise, help diagnose the trouble, and determine quickly where to make repairs without tearing down the entire equipment.

This instrument, complete with high impedance type headphones,



"Scallop-Edge" abrasive belt for finishing jet blades



Anco friction noise detecting equipment

batteries, and leather carrying case, is obtainable from the Anco Instrument Division, 4254 W. Arthington, Chicago 24, Ill.

Technica Vertical Milling Machine

The Carl Hirschmann Co., 30 Park Ave., Manhasset, N.Y., representative in U.S. of Technica, A.G., Grenchen, Switzerland, is introducing in this country a vertical milling machine built by the latter company. It is especially designed for milling grooves and slits in small parts, and similar precision work. This Type 1100 machine should be of particular interest to instrument makers.

The collet type milling spindle has a capacity of 5/16 inch, and the taper type spindle has a No. 1 Morse taper. Maximum spindle speed is about 6000 R.P.M. The milling machine table is 5 inches in diameter, and has a transverse movement of 1 9/16 inches and a longitudinal movement of 2 inches.

Special accessories available for the machine include round working table with 0.001-inch graduations; flat table; quick clamping pivoted vise; work-holding jaws; and special milling devices.

Improved Hamilton Gear-Hobber

An improvement in the design of the hob-spindle assembly of the No. 1 gear-hobber built by the Hamilton Tool Co., Hamilton, Ohio, has recently been announced. This change in design permits a 180-degree rotation of the hob-spindle turntable, and reverse rotation of the hob-spindle itself, without change of work-spindle rotation or direction of feed. Also, the machine can now use both straight-hole hobs and tapered-hole hobs with taper either right to left or left to right.

Thus, the work-spindle and hob-spindle can be reversed independently of each other, and the direction of feed of either can be changed independently of the other. Both conventional and climb hobbing with either straight-hole or tapered-hole hobs can now be done from front to back or from back to front.

This change in hob-spindle assembly extends the feature of independent selection of speed, feed, and indexing characteristic of the machine, and also provides the required degree of flexibility. Hamilton No. 1 gear-hobbers now in use can be changed over to provide the new features outlined.



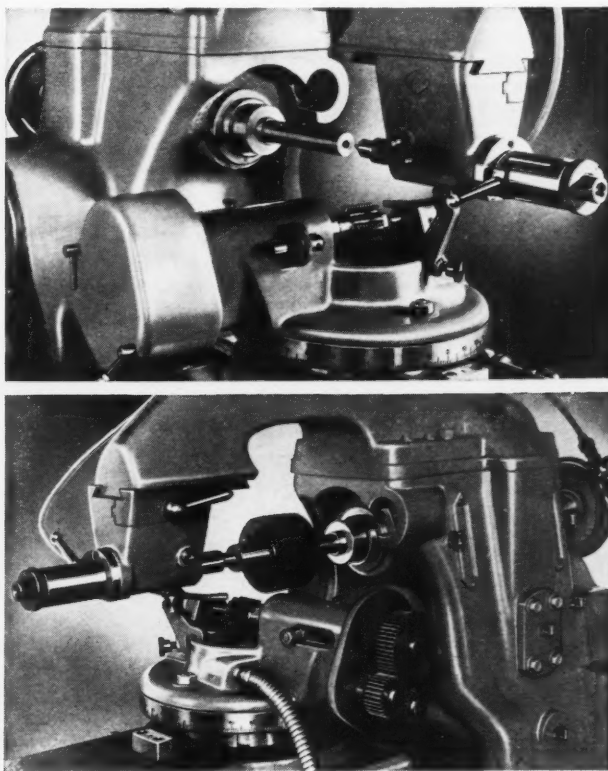
"Diskette" high-speed disc grinder introduced by Balmar Corporation

"Diskette" High-Speed Disc Grinder

Designed for one-hand operation in the machine shop, the new precision high-speed disc grinder introduced by the Balmar Corporation, Woodberry, Baltimore 11, Md., is only 9 inches long and weighs but 4 1/2 pounds. This tool, known as the "Diskette" is suitable for polishing, grinding, sharpening, and shaping all kinds of metals. Having a speed of approximately 8000 R.P.M. it can be used to produce smooth finishes and highly polished surfaces.



Technica vertical milling machine for small precision work



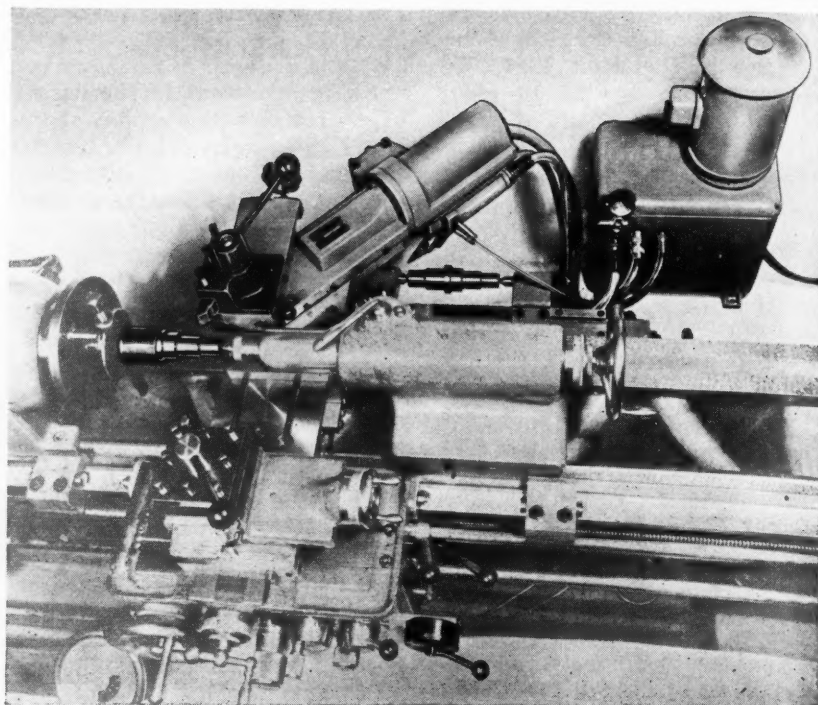
Two views of improved Hamilton gear-hobbing machine

Among its many machine shop uses are cleaning metal surfaces for brazing or soldering; cutting off protruding nails, screws, and rivets; smoothing hammer or dent marks; sharpening cutters, saws, and other shop tools.

Because of its small size and light weight, the "Diskette" can be easily operated in close quarters. The outside diameter of the tool is 2 3/4 inches, and the weight approximately half that of comparable hand tools. Special attachments permit its use for hole-burring, hole-polishing, rotary filing and cutting, and solder cutting. The motor with which the tool is equipped operates on 110-volt alternating or direct current.

Hydraulic Copying Attachment for Lathe

The "Bondycop"—a new Swiss hydraulic copying attachment for lathes—is being introduced in this country by the Morey Machinery Co., Inc., 410 Broome St., New York 13, N. Y. This attachment makes it possible to turn almost any lathe into an automatic tracer-controlled machine. Mass production is said to be practical even for small-lot jobs because setting of the attachment usually takes but a few minutes. Once set, the



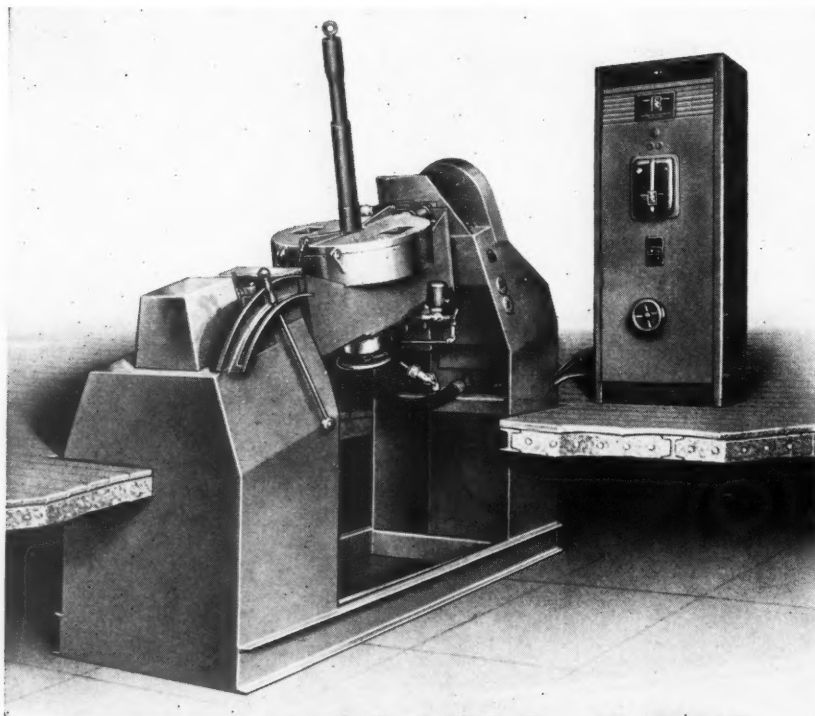
Lathe equipped with new "Bondycop" hydraulic copying attachment, introduced by the Morey Machinery Co., Inc.

attachment need not be removed when not in use.

For a pattern, the "Bondycop" uses either the first piece of a lot or a jig. Since the operator controls only one measurement, the chance of error is reduced to a minimum. The attachment will

copy angles of 90 degrees in the direction of the headstock, allowing a heavy cut that will insure a smooth surface and save grinding operations. The standard unit can be used for all diameters up to 6 inches, and can be supplied in sizes ranging from 40 to 80 inches between centers.

The four essential parts of the "Bondycop" are the motor; the jig-holder, fixed at the rear of the lathe; the hydraulically controlled tool-holder; and the control lever. The attachment can also be used for milling.



Positioner for use in welding jet-engine turbine blades, built by the Syracuse Special Machine Co.

Positioner for Welding Jet-Engine Turbine Wheels

A new J-47 positioner for use in welding jet-engine turbine wheels is being manufactured by the Syracuse Special Machine Co., 4010 Court St., East Syracuse, N. Y. While designed for hand welding, the positioner can be easily adapted for automatic welding. In welding the turbine-bucket wheel to the forged shaft of a turbo-jet engine, the bead is laid down on both sides of the wheel in an exactly defined sequence, and the welded area must be kept at a temperature of 600 degrees F.

The positioner consists of a cradle, which is power-rotated through an angle of 180 degrees,

so that welding can be performed on both sides of the assembly. The assembly is carried on a variable-speed rotating spindle, and is enclosed by insulated doors equipped with ports for welding. Thus the operators have clear access to the work and yet are protected from heat and splatter.

The assembly is maintained at the required heat—600 degrees F.—by means of gas burners controlled by motor-operated gas valves and manually operated secondary air valves. An interlocking system of electric controls maintains ignition, firing, and gas pressure. Welding speed can be varied as required by means of a special heavy-duty, variable-speed gear reducer designed to withstand the chipping hammer blows.

Templets of Machine Tools for Plant Lay-Outs

Repro-Templets, Inc., Oakmont, Allegheny County, Pa., has announced a complete, alphabetically indexed master file of machine tool and shop equipment templets made to a scale of 1/4 inch to the foot on film sheets 12 by 18 inches. The 5000 templets included cover the most widely used machines and equipment made by 160 manufacturers. These templets permit the engineer to quickly reproduce by commercial methods any number of individual templets needed to lay out practically any metal-working plant.

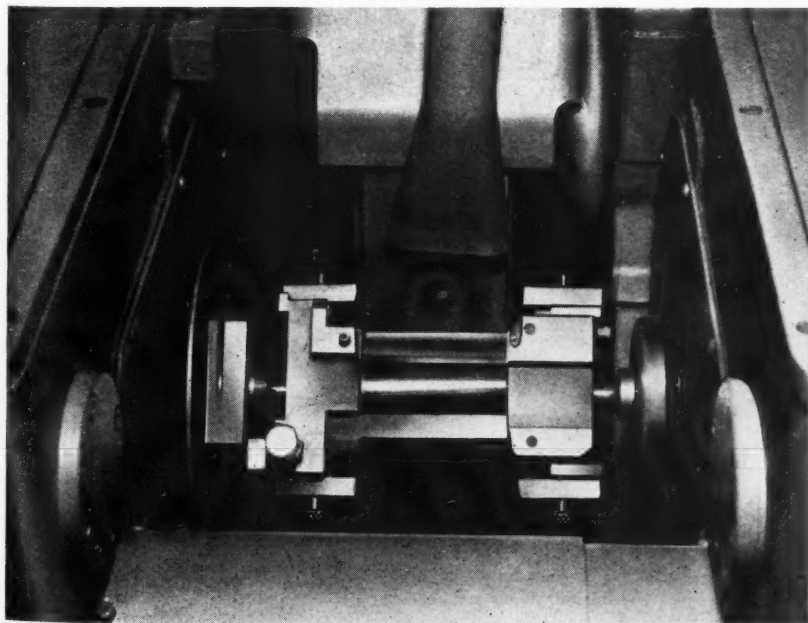


Fig. 2. Close-up view of work being ground in new Norton machine

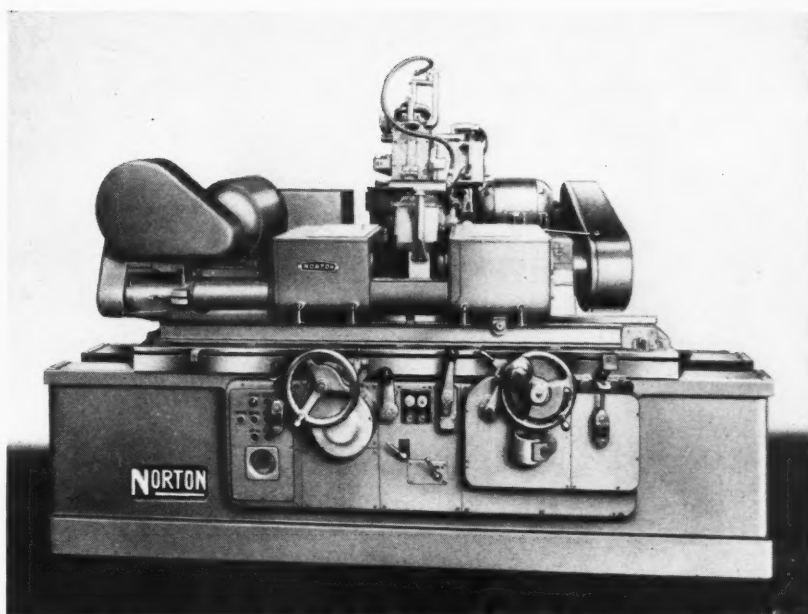


Fig. 1. Front view of new compound-contour jet blade grinding machine developed by the Norton Co.

Norton Compound Contour Jet Blade Grinder

The Norton Co., Worcester, Mass., has developed a new machine for the rapid precision grinding of external airfoil surfaces on jet-engine turbine blades, buckets, vanes, nozzles, and similar work on a production basis. Blades to be form-ground are held on an arbor between synchronously driven, left-hand and right-hand shape-producing units, as shown in Fig. 2. These units impart the required figure 8 motion to the arbor for grinding the blade

forms. The cams in each unit impart a rise and fall movement to the work-spindle, together with an in-and-out swinging motion for controlling the blade shape.

By arranging the machine units in their correct relationship, the path of the rotating work-spindles can be so controlled as to cause the blade to be ground to a varying shape from one end to the other, provided that the contour consists of a straight-line, faired design. The straight lines of the design need not be parallel to each other. The shaping motion presents the surface to be ground at the horizontal center line of a wide wheel, which grinds the airfoil surface in one plunge cut.

The work-arbor is removable, and is supported by ball-nose centers, which are held in the spindles of the shape-producing units. The arbor is designed to suit the specific conditions of the blade and to support the blade at the required angle. Design of the blade determines the number that can be held on the arbor. Certain designs permit two or three blades to be accommodated. One arbor can be used for loading while another is holding work in the machine.

The machine is equipped for an automatic grinding cycle operation. The Norton automatic wheel guard type truing device, operating under push-button control, is available with this machine.

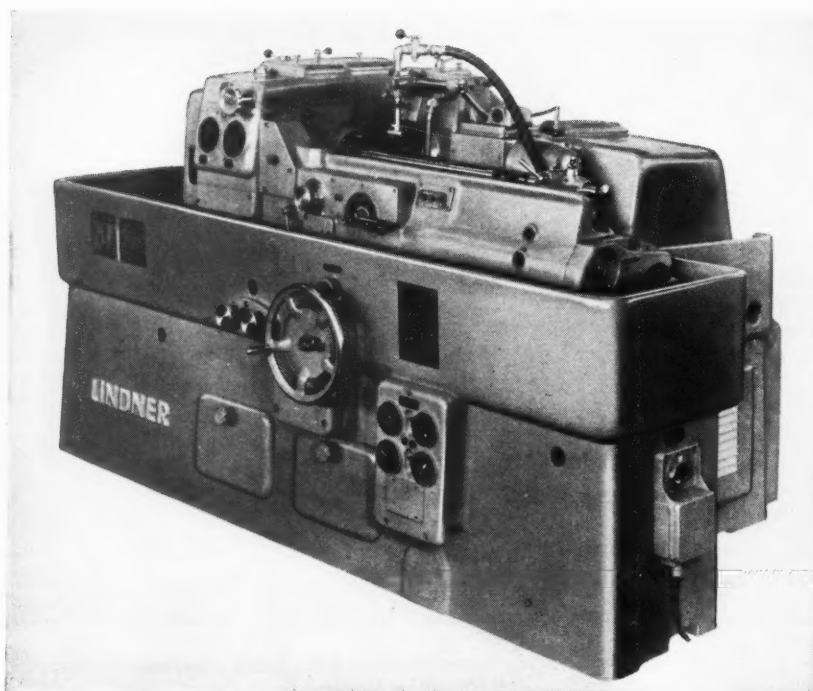


Fig. 1. Lindner standard type grinding machine introduced in this country by the Kurt Orban Co., Inc.

Lindner Thread Grinders Designed for Wide Range of High-Precision Work

Exceptionally close tolerances on both traverse and plunge grinding work can be maintained by four standard types of Lindner thread grinding machines, which are being distributed in the United States by the Kurt Orban Co., Inc., 205 E. 42nd St., New York 17, N. Y. It is claimed that lead tolerances on these machines can be held within 0.00008 inch over a length of 1 inch, and within 0.00024 inch over 20 inches. Pitch tolerances can be held within 0.0002 inch per inch.

While all four types of grinders incorporate the same fundamental design principles, each is specifically built for a particular range of tool-room or high-production work. The Type A machine is designed for internal and external grinding of high-precision micrometer spindles, thread gages, and similar work that does not require a relieving action. Type B is a universal grinder adapted for the tool-room, and is suitable for internal and external grinding of gages, threading and cutting tools, hobs, and profile cutters, using single or multiple profile wheels.

The Type C grinder is a production machine with relieving attachment. It is particularly adapted to the needs of manufacturing

plants producing tools requiring the use of both single and multiple profile wheels. Type D is a production machine designed to grind precision threads and forms by plunge grinding with a wide double profile wheel.

All models have a hardened and ground lead-screw. The entire work-table, which carries the headstock and tailstock, can be tilted in relation to the grinding

wheel. Fine adjustment is provided for setting up a pre-cut thread, and a dial calculator permits quick determination of the helix angle.

By means of attachments, the machines can be used for grinding thread forms and profiles on flat surfaces, permitting the grinding of tangential and radial threading dies, anvils for thread gages and micrometers, die chasers, flat gages, racks, and similar work. Small grinding wheels can be used for internal threads and profiles and for relieving milling cutters. Grinding wheels are redressed by a number of methods, including a motor-driven copying device and a profile roll device.

All four models are available in two sizes—one with a center distance of approximately 15 3/4 inches and a maximum thread grinding length of about 10 inches; and the other with a center distance of 31 1/2 inches and a maximum thread grinding length of 19 1/2 inches. On both sizes the maximum grinding diameter is approximately 10 inches based on a length of 4 inches measured from the spindle nose, or about 8 inches based on total length.

Welding Oven for Drying Electrodes

The Despatch Oven Co., Minneapolis 14, Minn., has announced a new drying oven designed to eliminate moisture absorption in

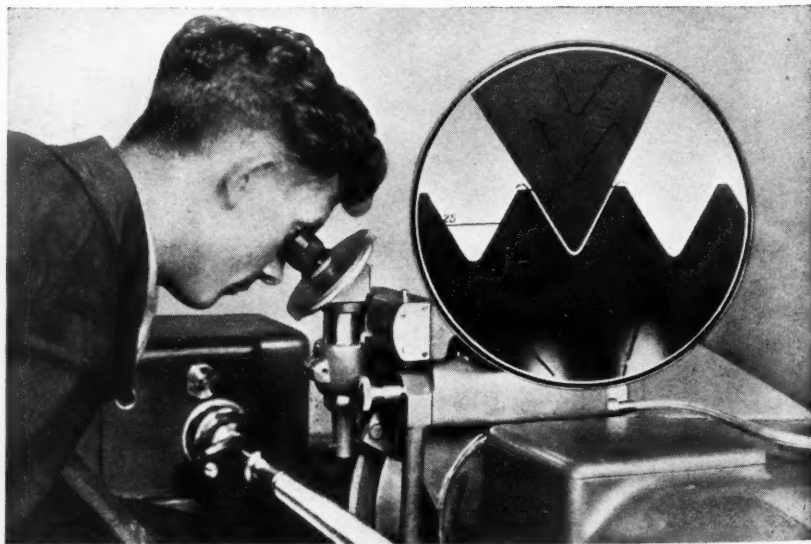


Fig. 2. Micro-optical system of Lindner machine shown in Fig. 1, which provides for checking ground profile of wheels or work contours on the machine



Oven for drying welding rods recently introduced by the Despatch Oven Co.



"Intrimik" internal tri-point micrometer for measuring bores and holes

low-hydrogen and other coated electrodes and thus assure high welding efficiency. Effective heating and economical storage can be provided for the rods by the drying oven at the location where the welding is done, enabling the welder to maintain an even flow of work. This system serves to cut down rework costs and lessen under-bead cracking and rough welds.

The oven is designed to occupy a minimum of space. It has ten separate compartments which hold a total of 250 pounds of electrodes. These compartments are removable for handling larger units. Reinforced mesh shelving permits efficient circulation of heat and controls moisture. The oven is also said to meet the requirements for low-cost equipment for preheating, aging, drying, and dehydrating operations.

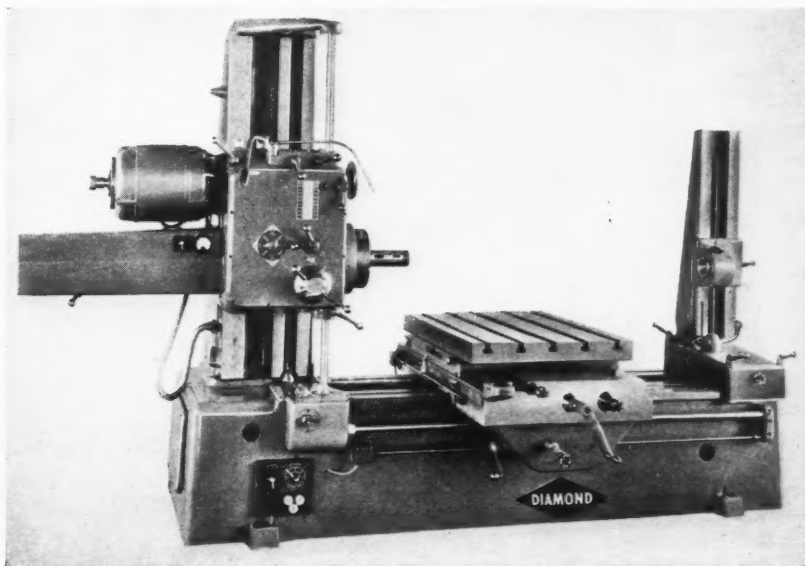
Horizontal Boring Mill

The Diamond Machine Tool Co., 3429 E. Olympic Blvd., Los Angeles 23, Calif., has brought out a new 3-inch horizontal boring mill designated the AL72. This machine is said to have all the features of much larger mills. It has eighteen feeds, with rapid traverse in all directions; stepless control of feeds on facing head; and a heavy 10-H.P. motor with amperage load regulator.

The spindle has a No. 5 Morse taper. It is 3 inches in diameter, and has a maximum travel of 32 1/4 inches and sixteen speeds. The platform is 25 inches in diameter, and the turntable 34 1/4 by 25 1/4 inches. Longitudinal travel of the table is 45 1/4 to 57 7/8 inches, and transverse movement 24 inches. The maximum distance of spindle above the table is 29 7/8 inches and from the platform to counter support 70 inches. Approximate weight of machine is 10,120 pounds.

B & S "Intrimik" for Precision Bore Measuring

Bore and hole diameters can be measured directly, without the use of masters, by a new internal three-point micrometer called the "Intrimik." This tool has been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I., for sale in the United States and its territories only. It will take inside measurements directly in increments of 0.0001 inch from 0.275 to 0.500 inch or in increments of



New horizontal boring mill placed on the market by the Diamond Machine Tool Co.

0.0002 inch from 0.500 inch to 4.000 inches.

These measurements can be taken easily and quickly at depths of 2 inches in the case of the three smaller sizes, and at depths of 3 inches when the larger sizes are used. Extension rods available as extra equipment permit taking measurements at depths up to 10 and 15 inches.

The unique design of the "In-

trimik" causes the three sensitive measuring points to make line contacts with the surface of the bore or hole, so that the instrument aligns itself accurately, both axially and radially. Individual instruments are made in sixteen different size ranges, and four sets of tools are available. Setting rings and extensions are furnished with sets, and may be had with individual instruments.

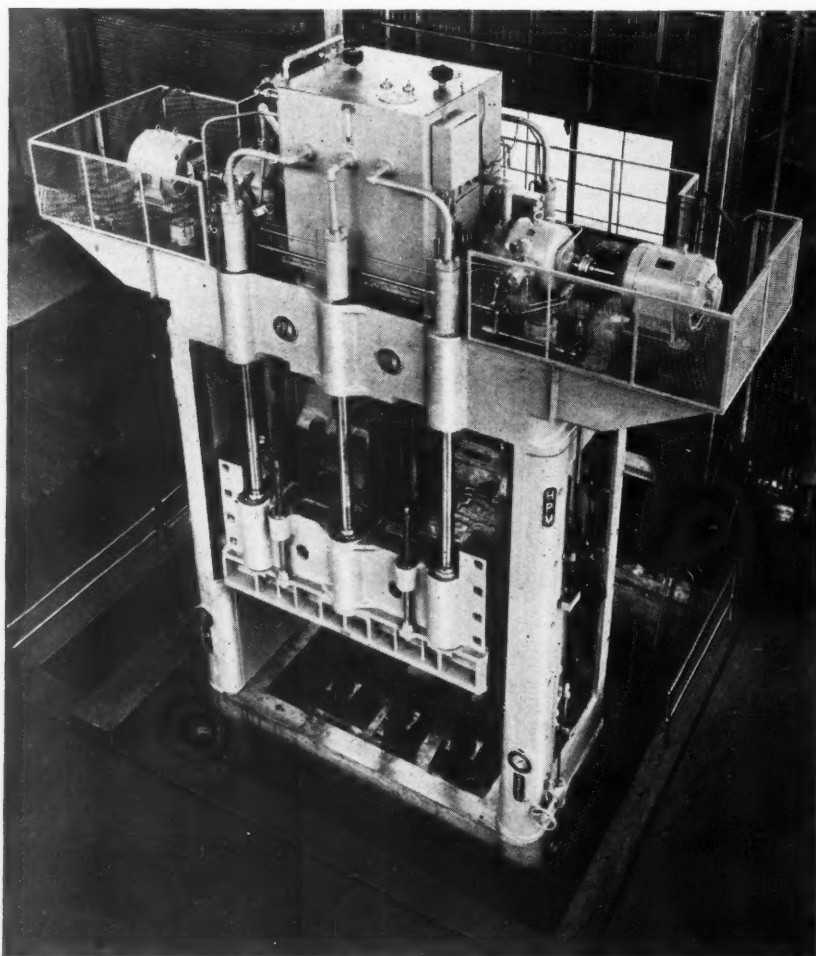
H-P-M Giant Size Blank-Holder Press

A giant size blank-holder press has been built by the Hydraulic Press Mfg. Co., 1042 Marion Road, Mount Gilead, Ohio, for Van Doorne's Automob'elfabriek N.V., Eindhoven, Holland, which will be used for the production of truck body parts, such as cabs, fenders, hoods, etc. The press is shown in the illustration completely assembled "in the pit" at the builder's plant, where it was tested before being dismantled for shipment.

This high-speed 750-ton capacity production unit is equipped with a 400-ton blank-holder and a 133-ton die cushion. The bed is 144

by 84 inches. The stroke is 56 inches, and the daylight capacity 146 inches. Height of press above floor level is 31 feet, and press mechanism extends 5 feet 7 inches below the floor level. The weight is approximately 346,000 pounds.

The press is powered by H-P-M's "Fast Traverse," all-hydraulic closed circuit power system, which permits accurate control of the large moving weights. Ram travel to and from work is at a rate of 350 inches per minute. There is an automatic slow-down as the die contacts the work to a forming speed of 60 inches per minute.



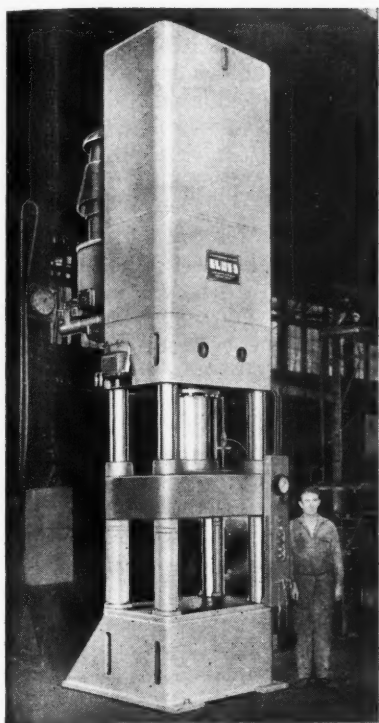
Precision drilling machine with wide speed range brought out by the Electro-Mechano Co.

Electro-Mechano Variable-Speed Precision Drilling Machines

Instant selection of any speed from 150 to 4000 R.P.M. is possible on the new variable-speed drilling machine built by the Electro-Mechano Co., 261 E. Erie St., Milwaukee, Wis. This machine is available in a bench model with counterbalanced head and in a floor model with tilting table. The head of these machines is of rugged, compact design, and encloses the speed control and motor. A direct reading, infinitely variable spindle speed control dial, together with a drill speed, drill size, and material chart, is located at the front of the housing. The variable sheave diameter speed converter permits instant continuous speed selection—from slow to fast—while running.

The Electro-Mechano machines have a drilling capacity of 1/16 to 1/2 inch with a quill stroke of 4 inches. The 1/2-H.P., 1740-R.P.M. built-in motor has lubricated and sealed ball bearings and can be operated on single-phase, capacitor-start, 115/230-volt, alternating current or three-phase, 220/440-volt circuits.

Blank-holder press for production of automotive parts, built by the Hydraulic Press Mfg. Co.



Elmes press built for use in artillery projectile production

Elmes Pipeless Hydraulic Press Designed for Shell Production Work

A new pipeless hydraulic press has been built by American Steel Foundries, Elmes Engineering Division, 1150 Tennessee Ave., Cincinnati 29, Ohio, and is now being used in the production of artillery projectiles. In this press, conventional high-pressure piping has been entirely eliminated from the main hydraulic circuit. All high-pressure fluid in the main circuit is conducted through short direct passages drilled in the structural parts. With this construction there are no high-pressure screwed joints and no welded joints or fittings that can possibly become loose or allow oil to drip.

As a result of freedom from main-circuit high-pressure piping troubles, press "down" time and maintenance expense are said to have been practically eliminated, with a corresponding increase in man-hour productivity. Any type of Elmes metal-working press can now be supplied with the new pipeless construction.

Colonial pull-down broaching machine designed to produce large tapered splines in a variety of parts

Colonial Pull-Down Broaching Machine for Producing Large Tapered Splines

Use of the broaching process in the production of accurate tapered splines on several different sizes of parts is possible with a broaching machine developed by the Colonial Broach Co., P. O. Box 37, Harper Station, Detroit 13, Mich. The broaching machine is basically a Colonial 15-ton, 66-inch stroke pull-down model equipped with a special table and an adjustable short shuttle travel.

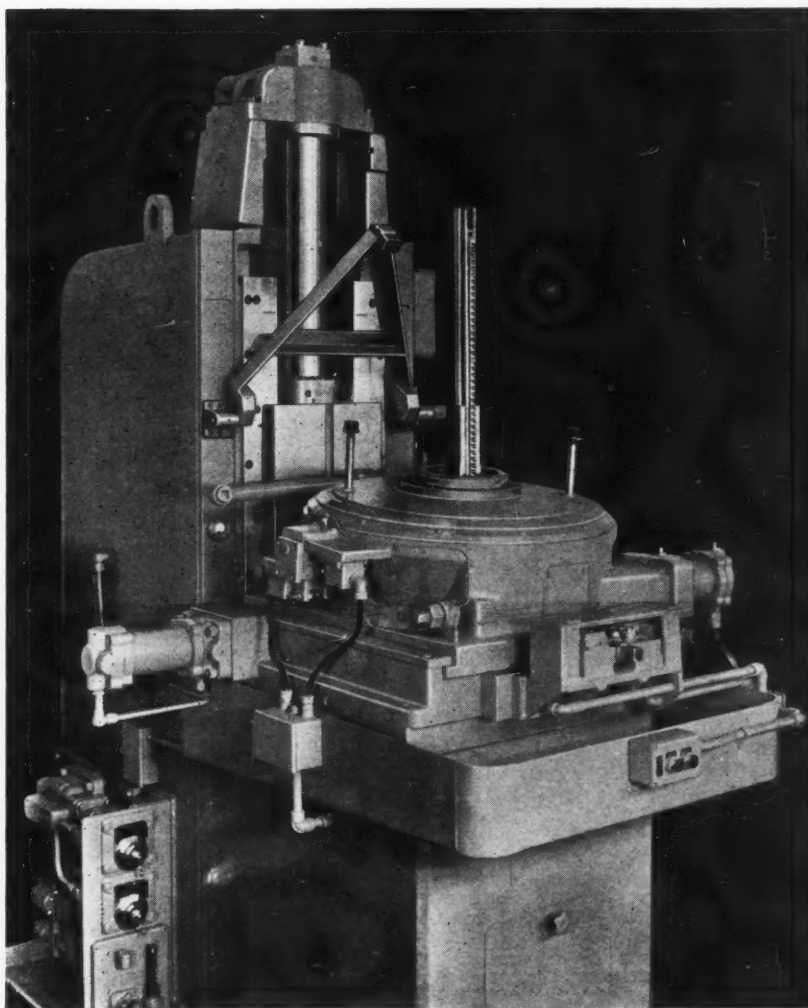
The machine illustrated is designed to produce several sizes of angular straight-sided splines in tractor sprocket wheels of varying outside diameters. The tractor wheel is placed over the broach tower on a fixture plate with the broach in the "down" position. The angle of the plate is such that the broach, which travels vertically, will produce splines with the correct amount of taper. The parts are held in position with hold-down studs and a clamp.

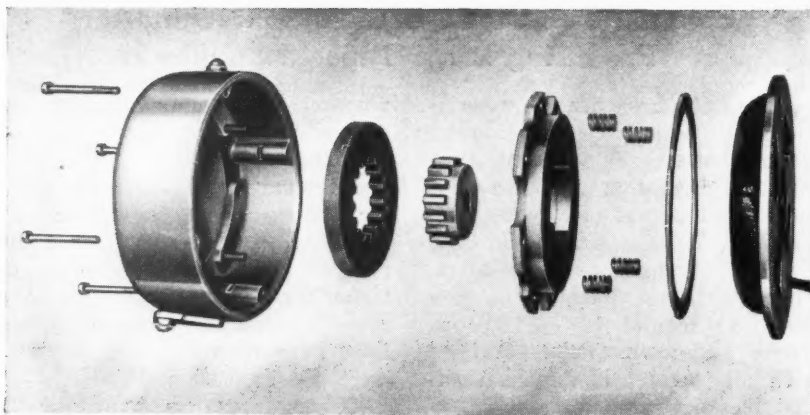
When the part is clamped in

position, the "start" button is pressed and the machine starts an automatic operating cycle. The broach travels up, the table shuttles into position for broaching, the broach travels down, the table recedes, the fixture indexes to position for the next spline, and the cycle is repeated. When all splines have been produced, the machine stops for unloading.

The machine is hydraulically operated throughout under electrical control. A hinged arm on the machine column is swung into position by a manually controlled hydraulic cylinder after the part has been loaded into place. This arm backs up the broach guide during the cut and thus avoids broach deflection.

Cutting time for the broaching operation is kept to a minimum, and maximum rigidity of fixture mounting is assured by the small amount of shuttle movement. On the tractor wheel, the maximum





Exploded view of Reuland magnetic brake

shuttle movement is $\frac{3}{8}$ inch. Some sizes of splines in the hubs permit the shuttle movement to be adjusted to $\frac{3}{16}$ inch.

The largest part broached on the machine has an outside diameter of 42 inches. Concentricity of splines with the outside diameter of the parts is achieved by fitting the outside diameter into a ground hole in the fixture plate. Fixture plates are interchanged to suit the various parts.

parts. One of the operational features is a direct, automatic set and release action between the solenoid and armature. The solenoid is of a one-piece "doughnut" design that permits the output shaft of the motor on which it is used to extend completely through the brake. This arrangement enables both ends of the shaft to be used for driving equipment.

The new magnetic brakes are

adapted for use in fluid-coupling motors and gear reducers because of the double-end shaft feature. The brake is installed on the output shaft of the fluid coupling with the shaft extending through the brake for coupling to the shaft to be driven.

Another feature of this brake is its light weight and short length. Automatic compensation for wear on the brake lining is provided by spring tension. Quick, direct action between solenoid and armature makes possible instant setting and releasing of brake.

Automatic operation permits the brake to be set by spring action when the current is cut off and to release magnetically when the current is reapplied. Manual release and automatic reset enable the output shaft of the motor to be rotated by hand and the brake to be automatically reset when current is applied.

These magnetic brakes are available in 3-, 10-, and 25-foot-pound continuous-duty ratings and in 15- and 35-foot-pound intermittent-duty types.

Reuland Magnetic Brake

The accompanying illustration shows a completely new magnetic brake developed by the Reuland Electric Co., Alhambra, Calif. It will be seen that the brake contains only six major operating

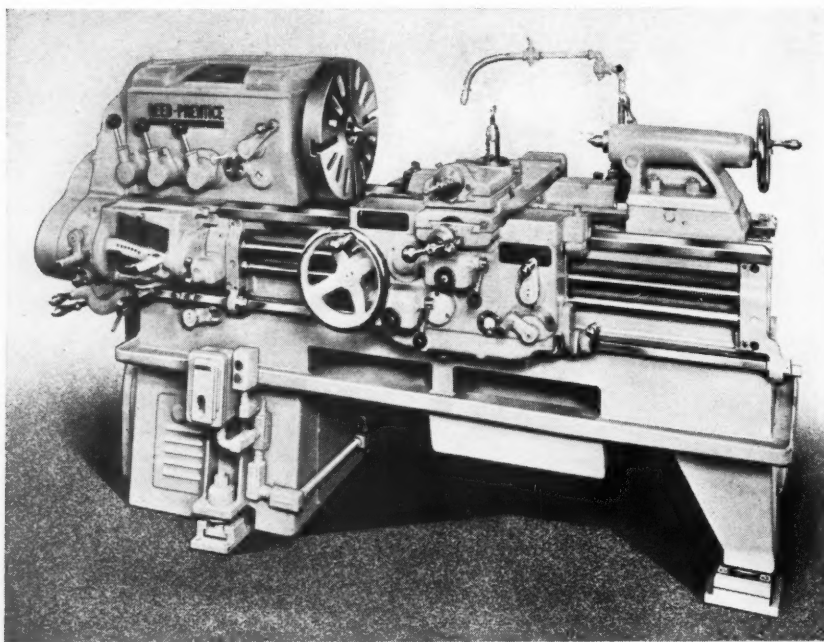
Reed-Prentice Lathe of Welded Construction

A specially designed engine lathe developed to provide a satisfactory solution to the problem of maintaining accuracy and alignment in precision metal-working lathes aboard ship is being manufactured by the Reed-Prentice

Corporation, 677 Cambridge St., Worcester 4, Mass. The new lathe compensates for the lack of level foundations aboard ship, and will withstand shocks such as might be caused by gunfire. It is of welded steel construction, and has a fabricated steel bed to which are attached hardened steel ways, designed for permanent accuracy.

The bed of the lathe rests on a full-length base supported by welded steel legs, set on three cushioned bearings. These bearings sustain the weight of the lathe and anchor it to the ship's deck. In addition, each cushioned bearing has an individual function. The rear bearing serves as a pivot, while the front bearing near the headstock allows horizontal motion at right angles to the axis of the work center. The cushioned bearing at the tailstock end of the lathe allows horizontal motion in all directions and thus effectively block transmission of strains to the bed caused by changing deck conditions.

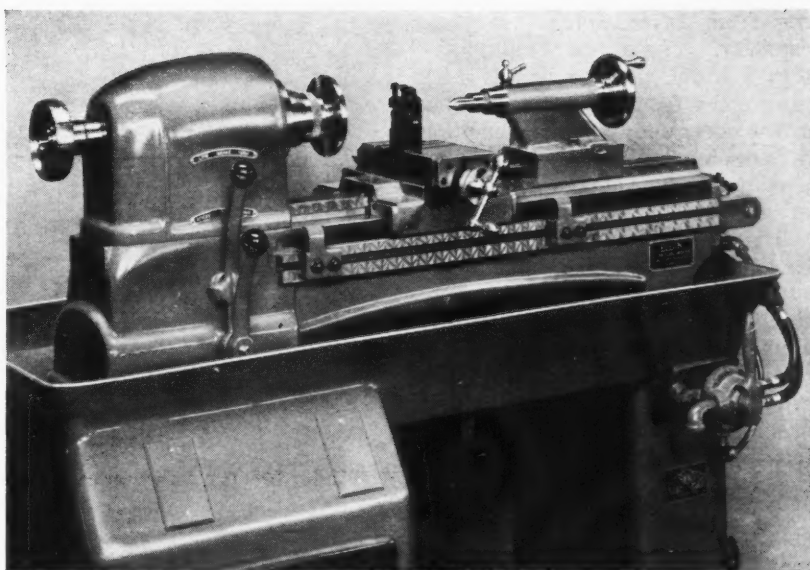
Designed primarily for sea duty, the lathe is also adaptable for land installation. It can be relocated as frequently as required and quickly made ready for use.



Lathe of welded construction for use on board ships recently announced by the Reed-Prentice Corporation

Elgin Precision Lathe with Air Power Feed

A new lathe specifically designed for the rapid production of small precision parts is being manufactured by the Elgin Tool Works, 1770 Berneau Ave., Chicago 13, Ill. This lathe has a longitudinal feed of 12 inches, which is actuated by an air cylinder. The speed of the air feed is hydraulically controlled, and a heavy stop is provided for accurate control of any length of feed desired. The lathe can be furnished with a pneumatic or a hand collet closer. Spindle speeds range from 120 to 3900 R.P.M.



Elgin precision lathe with hydraulically controlled air-actuated feed

Power-Driven Machine for Rapid Joining or Seaming of Sheet Metal

The Standard Power Groove Machine Corporation, 99 Hudson St., New York 13, N. Y., has developed a new sheet-metal joining or seaming machine designed to automatically seam sheet metal of any thickness from 18 to 30 gage. The machine, exerting a pressure of 11,000 pounds per square inch, quickly and permanently seams two sheets of metal.

The seaming pressure is derived from force which the roller assembly exerts against an overhead structural steel beam. The roller travels first in one direction, and then automatically reverses to perform the second and final operation, which smooths the seam. Square or round pipe or straight seaming work can be handled.

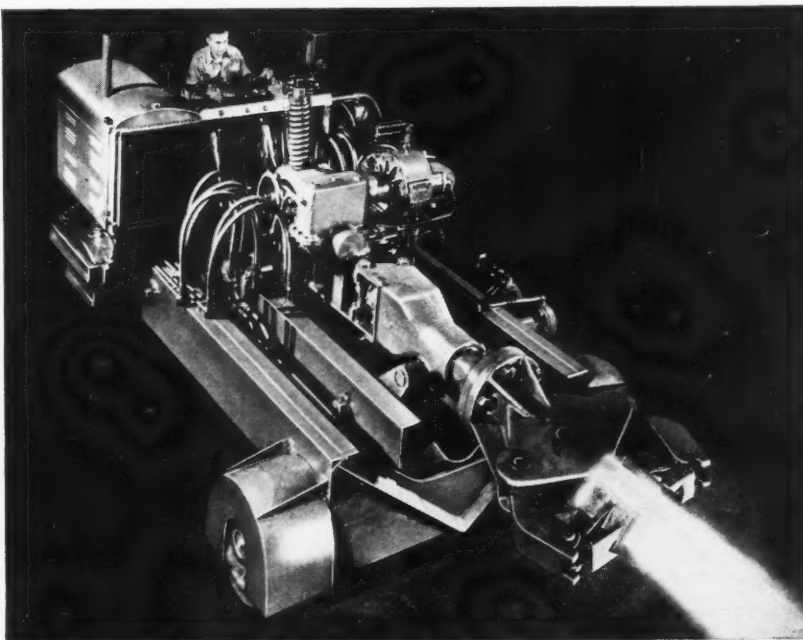
The machine will take any piping up to 8 feet in length, and has an over-all length of 10 feet. It is driven by a 2-H.P. motor.



Sheet-metal joining or seaming machine developed by the Standard Power Groove Machine Corporation

"Auto-Floor Manipulator" for Handling Hot Stock during Forging Operations

The Brosius "Auto-Floor Manipulator," for handling hot stock during forging, incorporates an improved wedge action in the work-holding tongs mechanism and a new positive-positioning feature in tongs shoes, which is said to assure certainty of grip and maneuverability. This equipment is designed and built by Salem-Brosius, Inc., Pittsburgh 15, Pa. It is made in sizes rang-



"Auto-Floor Manipulator" for handling hot stock during forging operations

ing from 1 to 10 tons carrying capacity. These floor manipulators are designed to handle forging stock from beginning to end of the operation, including loading of drawing furnaces and manipulating of the work while in the press.

The speed with which work can be handled by this equipment assures high-speed production cycles, a vital factor when forging aluminum, stainless steel, and other metals with narrow critical forging temperature ranges. Either gasoline or Diesel engines or electric motors can be used to power the equipment. The rotating, tilting, vertical, and lateral motions of the work-head give complete control of the work during forging operations.

New Helix Angle Adapter Developed for Use on Orlandi Gear Checker

The range of applications of the gear checker manufactured by the Orlandi Gear & Machine Co., 16195 Meyers Road, Detroit 27, Mich., has been increased by a helix angle adapter and a rolling attachment. The new adapter is said to simplify the set-up shown in Fig. 1 for checking helix angles to the point where practically all mathematical computations are eliminated. The size of the gage-block required for this set-up is determined by simply taking the sine of the helix angle from a table of trigonometrical functions, subtracting one-half the diameter of

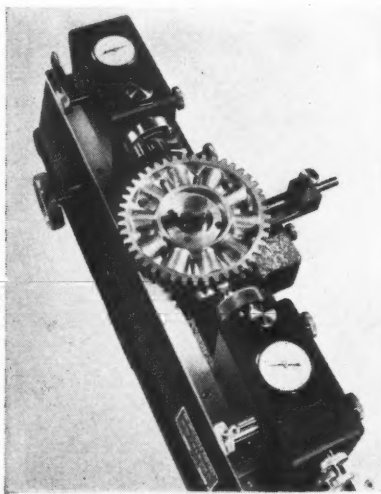
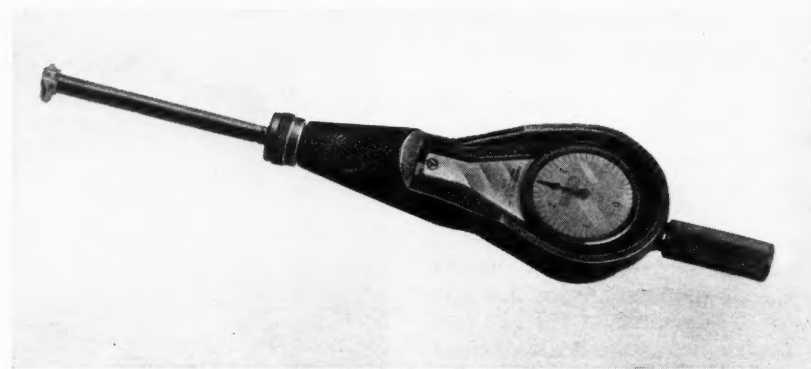


Fig. 1. Orlandi gear checker with adapter for checking helix angle of gear



Small-size dial bore gage announced by Standard Gage Co., Inc.

the adapter pin, and adding the result to the "constant" etched on the machine.

The new rolling attachment for use with a master gear (Fig. 2) makes possible the rapid checking

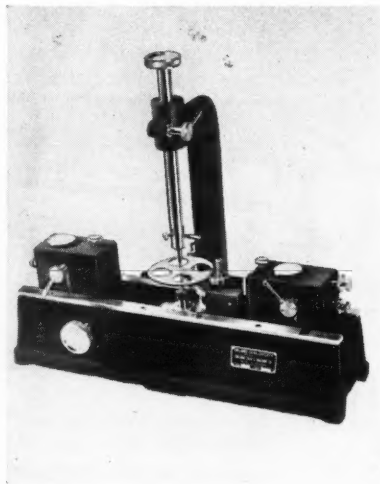


Fig. 2. Orlandi gear checker equipped with rolling attachment for checking pitch diameter and concentricity

of pitch diameter and concentricity to an accuracy of 0.0001 inch. With this attachment, backlash can also be easily and quickly checked either with mating gears or by means of properly selected master gears.

Other operations that can be performed with this tool include checking concentricity without a master; checking parallelism, backlash, root diameter, crown on face of tooth, tooth-to-tooth spacing, and accumulated error at 90 or 180 degrees. Concentricity of the outside diameter of ground gears, including those with odd numbers of teeth where a micrometer cannot be used, can also be checked with this equipment.

Small-Size Dial Bore Gage

The Standard Gage Co., Inc., Poughkeepsie, N. Y., has added to its line a new dial gage especially designed for quick, accurate inspection of small-diameter bores, from 0.250 to 0.375 inch. This Model No. 00 gage will check bores within a tolerance of 0.005 inch.

It utilizes interchangeable "centering size" discs, which are attached firmly to the head of the instrument, and are locked securely in place by means of a knurled clamping nut. The discs are made a few thousandths of an inch smaller than the bore to be gaged, and can be quickly released when they are to be interchanged by simply turning the clamping nut. Positive locking action of the clamping nut insures holding the set dimension.

The dial indicator is hooded as protection against accidental knocks, and has high visibility graduations of 0.0001 inch. The plunger actuating the indicator is sapphire-tipped, and the discs are chromium-plated to assure a long useful life.

In using the gage, it is entered at an angle to allow the extended plunger to clear the bore, and is then rocked to cause the plunger to pass the square or right-angle position while the minimum reading is noted on the indicator. It is claimed that positive repeat readings can be made with this instrument.

Wales "Hydra-Strip" Hole Punching Units

"Hydra-Strip" hole punching units for punching holes in mild steel up to 3/4 inch thick have just been announced by the Wales-Strippit Corporation, 345 Payne

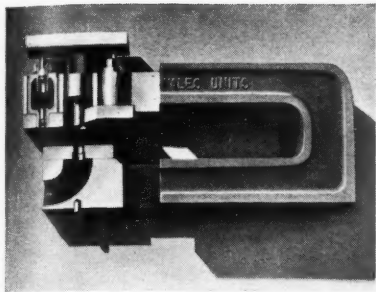


Fig. 1. Cut-away view of Wales "Hydra-Strip" hole punching unit showing two "Hydra-Springs," one on each side of the punch

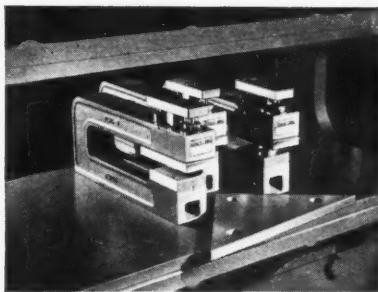


Fig. 2. Template set-up of "Hydra-Strip" hole punching units in a press brake. Work in the foreground with shaped and round holes is 3/4 inch thick

Ave., North Tonawanda, N. Y. The outstanding feature of these new Type HS extra heavy-duty units is the Wales "Hydra-Spring," which provides many times more stripping pressure than mechanical springs of the same volume by utilizing the compressibility of special fluids. The stripping pressure can be changed by a simple adjustment which increases or decreases the volume of the fluid.

The new hole punching units are self-contained and independent. All component parts are built into the holders, which keep the round or shaped punches and dies in perfect alignment for the life of the units. Unlike conventional dies, nothing is attached to the press ram, the only function of the ram being to depress the punch.

The same group of units can be set up on templates or T-slotted plates in stamping presses, and on rails, strip templates, or T-slotted plates in press brakes. This interchangeable use of the same group of units permits set-ups of unlimited hole punching patterns and the fabricating of parts the same day a hole punching design is released for production.



Exploded view of Carborundum universal hub contact wheel and interchangeable serrated rubber tires for use in abrasive belt grinding

Universal Contact Wheel for Abrasive Belt Grinding

A universal hub contact wheel for use in abrasive belt grinding has been announced recently by the Carborundum Co., Niagara Falls, N. Y. One universal hub and plate unit will take a variety of T-61 serrated rubber tires ranging in width from 1/4 inch

up to 6 inches and in hardness from 5 to 105 durometer rating.

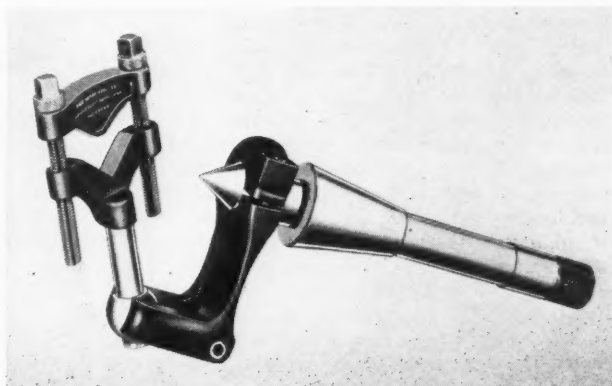
The interchangeable feature makes it possible for a single universal hub to take up to 144 different tires. This permits everything from rough belt grinding down to the finest finishing of flat surfaces or contoured parts to be done with the same basic hub and set of quick-change tires.

Each part of the universal hub assembly—hub wheel, plate, and tire—is separately balanced. Thus, all hubs, plates, and tires are not only interchangeable, but are in

balance in any combination of assembled contact wheel units. In those instances where old-type worn-out rubber contact wheels used to be recovered, it will now be more economical to discard the old tire and replace it with a new one. The new tire costs no more than the recovering of a solid-hub contact wheel, and time delays and shipping costs are eliminated.

Milling Machine Dog and Driver for Accurate Spacing on Taper Work

Milling machine dog and driver designed by the Ready Tool Co., 554 Iranistan Ave., Bridgeport, Conn., for accurate spacing on taper work and spiral cutting operations. The action of a hardened ball sliding on a hardened stud between the ground jaws of this driver acts as a universal stud between socket joint, so that work is never cramped or sprung. This dog and driver is supplied in two sizes: Style 130 with a capacity of from 1/4 inch to 2 inches, and Style 132 with a capacity of from 3/4 to 2 3/8 inches. They are regularly furnished with either a No. 10 or a No. 11 B & S taper. Also available with a No. 40 standard milling machine taper or any other special taper required.





Instrument for Testing Cleanliness of Aluminum Sheets Prior to Welding

"Microhm Meter" designed to test the cleanliness of aluminum sheets as prepared for welding. The tester measures the surface electrical resistance of the aluminum sheets in microhms, and thus determines the effectiveness of the oxide removal or cleaning process employed preparatory to welding. It can readily measure the total surface resistance of two sheets placed between dummy electrodes, accurately determining resistance as low as one millionth of an ohm. Made by J. W. Dice Co., 1 Engle St., Englewood, N. J.



Vise for Holding and Positioning Work

Cam-actuated vise, designed for rapid clamping and positioning, recently added to the line of "Powrarm" equipment made by the Wilton Tool Mfg. Co., 925 Wrightwood Ave., Chicago 14, Ill. Especially adapted for use in soldering and light electronic assembly work. It will securely hold work weighing up to 24 pounds. A knob controls a pressure pad under the swivel ball. The vise is adjustable through 360 degrees in the horizontal plane, 180 degrees in the vertical plane, and 360 degrees in the axial plane. The maximum jaw opening is 3/8 inch, and the cam travel 3/16 inch. The reinforced fiber jaws are 2 inches wide.

End-Mills and Die-Sinking Cutters

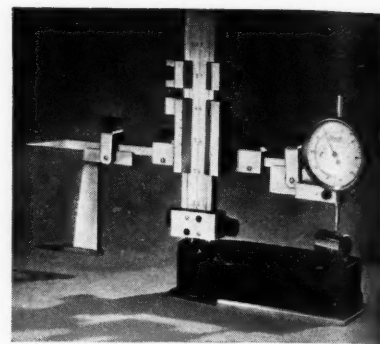
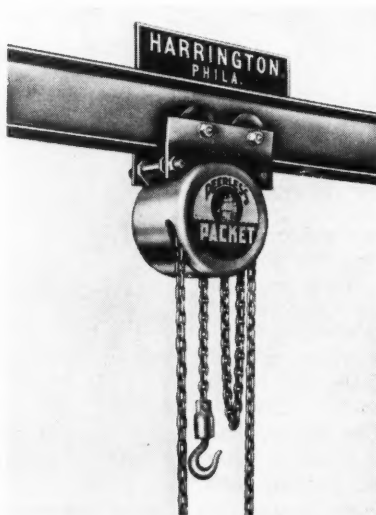
End-mills and die-sinking cutters of new line introduced by the Metal Removal Co., 1546 N. Orleans St., Chicago, Ill. This line is available from factory stocks in a wide range of standard sizes, in single- and double-end types, and in small and large diameters, with two, three, or four straight or spiral flutes, and straight or ball ends. The cutters



are processed from high-speed tool steel, and are heat-treated to provide maximum cutting life at minimum cost.

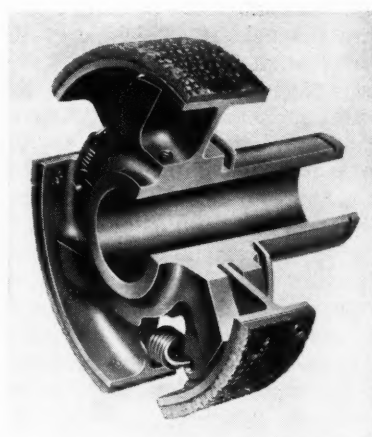
Peerless "Packet" Adjustable Trolley Hoist

New Peerless "Packet" trolley hoist manufactured in 1/2-, 1-, and 2-ton capacities by the Harrington Co., 17th and Callowhill Sts., Philadelphia 30, Pa. These hoists have the advantage of being adjustable for a range of I-beam sizes without dismantling. The high-carbon steel trolley wheels have large double-row ball bearings lubricated through the stud by a pressure grease gun. Other features are rugged, all-steel construction; precision cut gears of heat-treated alloy steel; and heat-treated, high-carbon steel chain for safe handling of load.



Universal Precision Height Gage

Universal precision height gage with a movable differential scale system for measuring and marking at any height within the range of the movable scale. With a special dial-indicator holder, this gage can also be used as a dial platform type instrument. The sliding scale arrangement permits measuring either up or down from any desired point. The long square scriber is hardened, ground, and lapped. It can be pushed out to measure 8 inches beyond the base on the 20-inch height gage. Made in 20-, 30-, and 40-inch sizes. Product of Brand Tool & Supply Co., 907 S. Victory Blvd., Burbank, Calif.

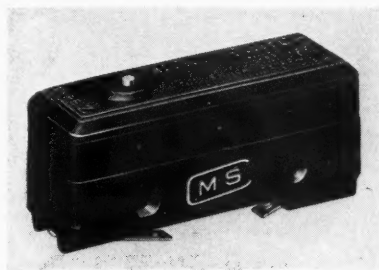


Elgin Centrifugal Clutch

Self-energizing automatic centrifugal clutch now being manufactured by the Elgin Sweeper Co., 6 Oak St., Elgin, Ill. Designed to insure maximum operating efficiency of any gasoline engine or electric motor whenever load-starting requires a large initial torque. Normal speed of the motor or engine on which the clutch is installed is reached before any load is applied. The clutch then automatically and smoothly picks up the load. It automatically disengages when engine or motor speed is reduced for idling. Four standard models are available with pulleys of various sizes. Can also be supplied in special designs to suit a variety of applications.

"Make-Before-Break" Snap Switch

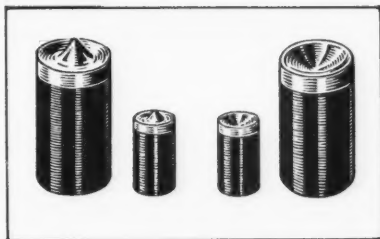
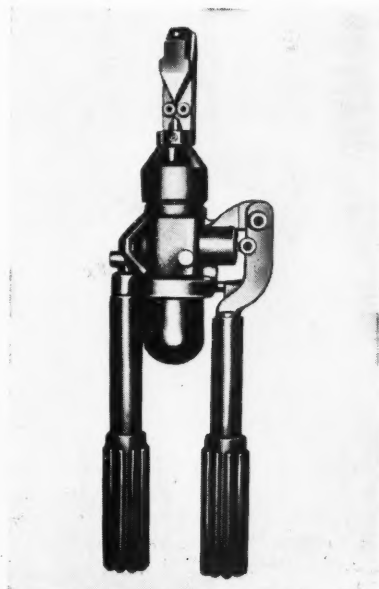
Switch designed to assure continuity of performance in a multi-stage machine that is controlled electrically. These BZ-2G switches provide a momentary overlap in circuits while switching from one stage to the next. The switch has two moving contact spring assemblies,



so adjusted that depression of the plunger actuates the lower contact from 0.005 to 0.010 inch before the upper one. In this momentary interval, both the normally open and normally closed circuits are closed to provide the make-before-break action of the contacts. To effect this make-before-break action, the actuating motion must not be faster than one inch per second at the switch plunger. Product of Micro Switch Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

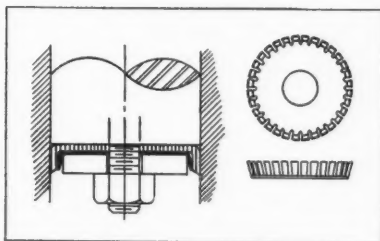
Hand-Operated Hydraulic Guillotine Rod Cutter

New Model 200-A guillotine hydraulic cutter only 12 pounds in weight and 21 inches long. Intended primarily to replace larger, more cumbersome bolt-cutters. Will cut up to 1/2-inch reinforcing rod. The easily resharpened blades are of alloy tool steel. Product of the Manco Mfg. Co., Bradley, Ill.



Carbide Rivet Sets and Rivet Heading Dies

Carbide rivet sets and heading dies introduced by Radius Tool Co., 672 Villa St., Elgin, Ill. These rivet sets and rivet and screw heading dies are said to prevent galling in the process of rivet setting, as the metal flows evenly and less pressure is required, due to the great hardness and mirror finish of the carbide. The rivet sets can be used on spinning, vibrating, or impact type machines. Dies and rivet sets are available in sizes from 1/8 to 3/4 inch.



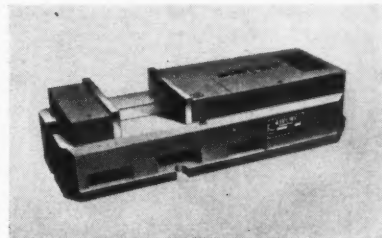
Brass Cup Expander for Cylinder Packings

Expanders developed to insure positive sealing action of cup packings by exerting controlled pressure on the packing lip, so that it maintains constant contact with the cylinder wall. These cup expanders are recommended for use on pumps, compressors, hydraulic presses, jacks, air cylinders, feed mechanisms, lubricators, etc. They are made from especially rolled strip brass, 0.010 inch thick, and are impervious to brine, gasoline, and alcohol. Available in sizes for use with all standard hydraulic and pneumatic packing diameters from 1 1/4 to 2 7/8 inches. Product of the HPL Mfg. Co., 15191 Miles Ave., Cleveland 28, Ohio.

Airlox Pneumatic Vise

Improved model Airlox pneumatic vise announced by Production Devices, Inc., Whitehall, N. Y. The air-operated wedge and lever arrangement of this vise gives a grip on the work equal to 100 times the air-line pressure. A new feature of the vise is the chip-plate and felt installation designed to reduce maintenance costs. The chip plate rides in a slot in the vise bed, and moves with the movable jaw. Felts recessed into the movable jaw act as wipers on

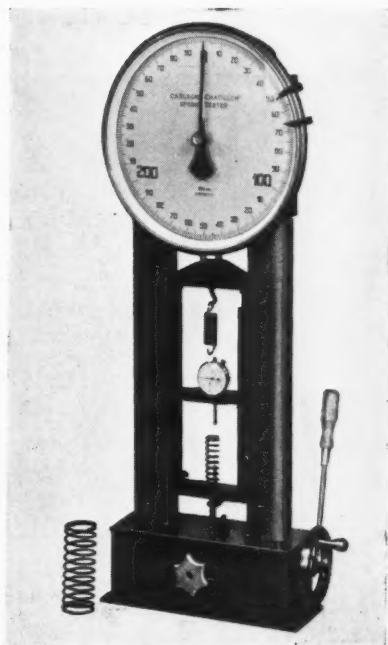
the vise bed. Similar felts are provided in the fixed jaw over the chip plate. This keeps small chips and dirt from clogging the movable jaw and from getting into the vise mechanism.



The new Model S-7 vise can be actuated from a motor-driven hydraulic circuit or from a separate motor-driven hydraulic unit when equipped with a special hydraulic cylinder.

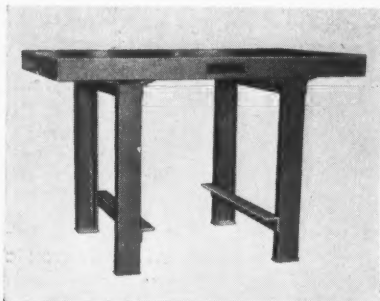
"Carlson-Chatillon" Spring Tester

New type "Carlson-Chatillon" spring tester designed for accurate checking of loads and deflections of compression and extension springs. Adapted for both general-purpose testing and high-quantity production testing at speeds of from 300 to 600 tests per hour. Stops and tolerance markers are easily adjustable, and accuracy is guaranteed within 1/4 of 1 per cent to meet National Bureau of Standards requirements. This tester has a capacity for loads up to 300 pounds, spring diameters up to 4 inches, and spring lengths up to 12 inches for compression and 10 inches for extension types. It has a base 14 1/2 inches wide by 5 inches deep, is 38 inches high, and weighs 70 pounds. Product of the Carlson Co., 277 Broadway, New York 7, N. Y.



Shop Utility Bench

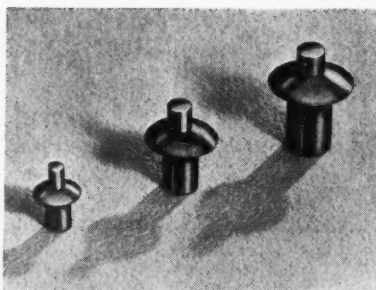
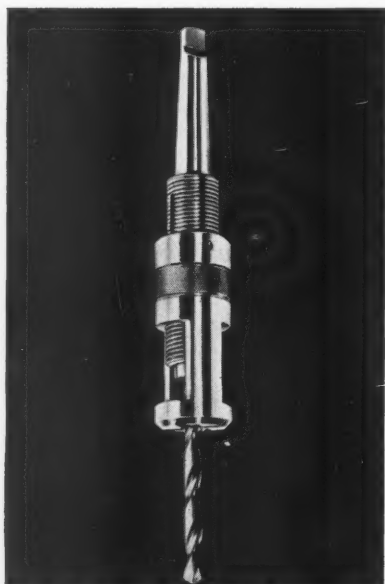
Utility bench designed to meet a wide range of shop requirements. This bench has a heavily ribbed 24- by 36-inch cast-iron top supported by four sturdily braced steel legs. Although light in



weight, it is ruggedly constructed. It is made in 36- and 30-inch heights. Announced by Challenge Machinery Co., Grand Haven, Mich.

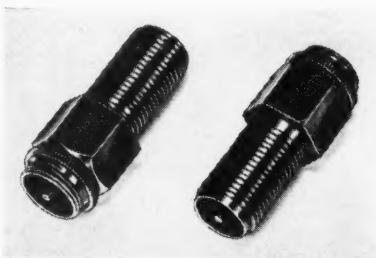
Drill Stop for Controlling Depth of Hole

Drill stop designed for use on turret lathes, drill presses, and radial drills. Announced by Scully-Jones & Co., 1906 S. Rockwell St., Chicago 8, Ill. This stop is especially adapted for operations like center drilling, drilling, and reaming, where close control of depth is required. A threaded lock bushing provides quick and accurate adjustment of the stop-collar. Tools can be removed by simply loosening set-screw and slipping stop-collar from threaded shank. A quarter turn of the set-screw forces the bushing against the shank threads, providing a positive lock. The small body diameter permits operation of the drill stop on close centers or near shoulders. Made in eight sizes having Morse taper shanks and holes.



Southco Small Size Drive Rivet

Three sizes of hammer-driven blind rivets now made by Southco Division, South Chester Corporation, 1418 S. Penn Square, Philadelphia 2, Pa. Like the larger 3/16- and 1/4-inch diameter drive rivets of this group now in production, the new smaller 1/8-inch drive rivet shown in the foreground can be installed by simply tapping home a pin with an ordinary hammer. This operation can be performed by one man and requires no bucking or special tools. Also there is no need for having access to the rear side of work. The 1/8-inch size is available in modified brazier or 100-degree countersunk head styles, with grip lengths of 1/32 to 13/32 inch.

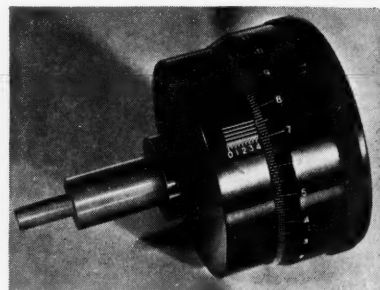


Mechanically Operated Electrical Impulse Generator

Electromagnetic pick-up designed to operate without physical contact when mounted near any moving magnetic material. This device is an electrical impulse generating unit that produces a voltage output proportional to the rate of motion or speed of the magnetic object. It may be actuated by the keyway in a shaft, the teeth of a gear, or similar moving part, or by any vibration or displacement of magnetic material in the field of the pick-up. Can be used for measuring acceleration and velocity; synchronizing cathode ray oscillograph sweep circuits; and indicating angular positions of rotating members. Will count operations in excess of 20,000 per second when used with electronic counters. The stainless steel body of the pick-up has one end threaded to facilitate installation. Manufactured by Electro Products Laboratories, Inc., 4501 N. Ravenswood Ave., Chicago 40, Ill.

Micrometer Head with Non-Rotating Spindle

New micrometer head with a spindle that does not rotate as it is advanced or retracted. The non-rotating spindle can be fitted with chisel or other special-



shaped anvils to suit various applications. Readings are made directly to 0.0001 inch and by vernier to 0.000025 inch. The lead-screw is ground from solid hardened and normalized stock, and has an over-all accuracy of 0.000050 inch in pitch throughout its working range. The instrument is designed for mounting on any mechanical or electronic device where accurate linear measurement or control is required. It is 3 5/8 inches in diameter, and is 5 inches long with the spindle fully retracted. Product of Boeckeler Instrument Co., 39 E. Rillito St., Tucson, Ariz.

Improved Arc-Welder

One of a line of recently redesigned alternating-current arc-welders announced by Metal & Thermit Corporation, 100 E. 42nd St., New York 17,

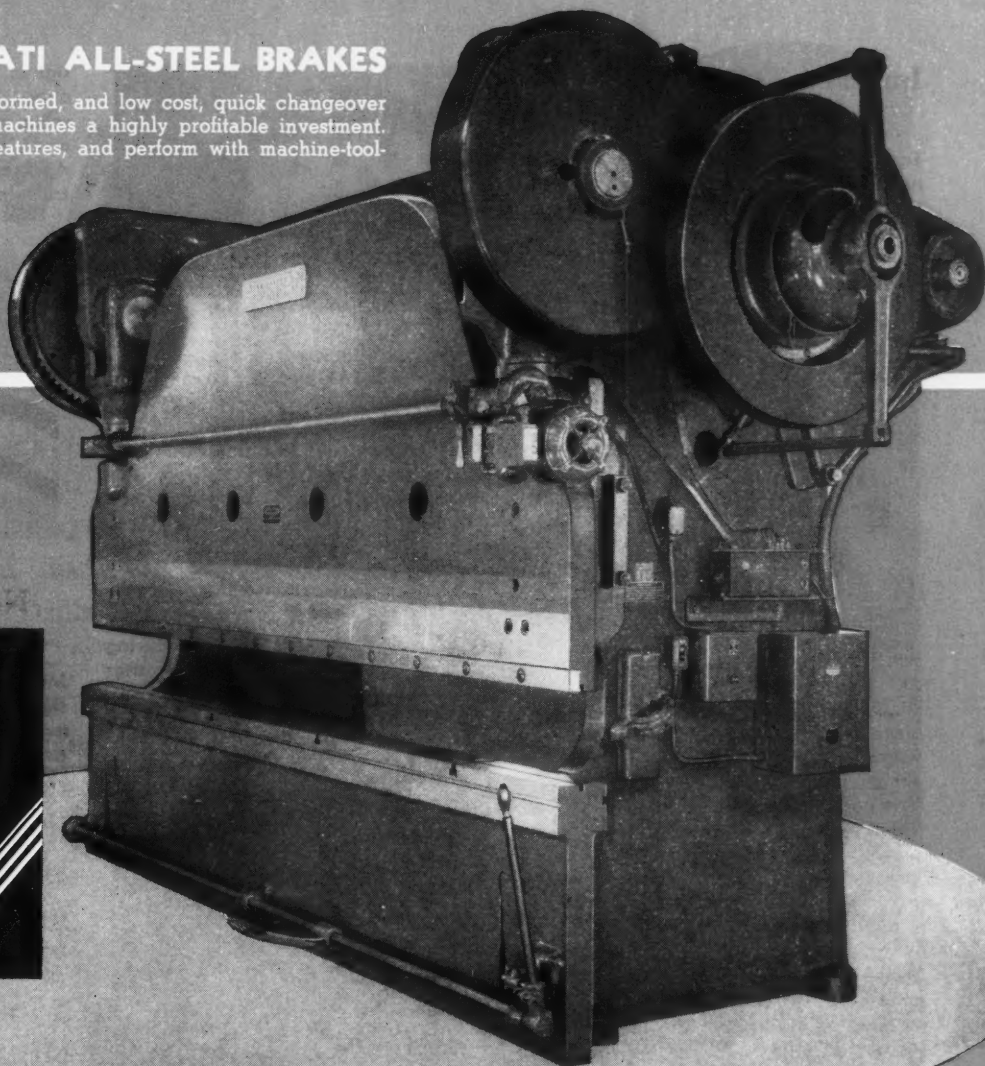


N. Y. Longer welder life, improved performance, and easier operation are outstanding features claimed for the new line, which includes welders having capacity ratings of 200, 300, 400, and 500 amperes.

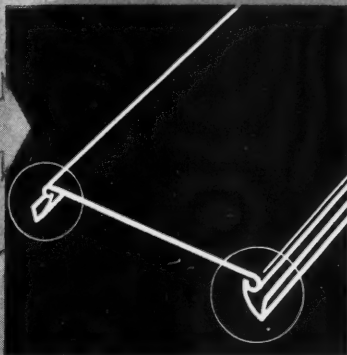


CINCINNATI ALL-STEEL BRAKES

The great variety of work performed, and low cost, quick changeover from job to job, make these machines a highly profitable investment. They have the most modern features, and perform with machine-tool-like accuracy on any job.



Parts like this display shelf are formed accurately on a Cincinnati to match up and fit together



THE ALL-STEEL TEAM of Cincinnati Shears and Cincinnati Press Brakes brings outstanding accuracy to the shop.

Without accuracy, manufacturing plans go wrong, production snarls, and profits fade.

With accuracy—discards, reworks and waste are out, and all along the production line parts fit accurately and speed assembly.

Cincinnati Shears cut accurate blanks and Cincinnati Press Brakes form accurate shapes. You save time, improve the product, and increase profits when you use the All-Steel Team—

Cincinnati Shears and Cincinnati Press Brakes.

Write for Shear Catalog S-6R, describing the Cincinnati Line—lengths from 4 feet through 24 feet, and capacities from light gauges through 1¼-inch plate.

Write for Press Brake Catalog B-4R, describing the Cincinnati Line—lengths from 2 feet to over 20 feet, and capacities from light gauges to 1000 tons.

Our Engineering Department will be glad to advise you on your shearing and forming problems.

THE CINCINNATI SHAPER CO.

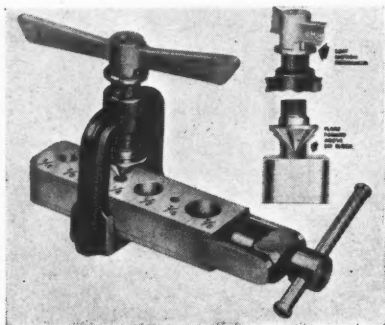
CINCINNATI 25, OHIO, U.S.A.

SHAPERS • SHEARS • BRAKES



Imperial Tube Flaring and Burnishing Tool

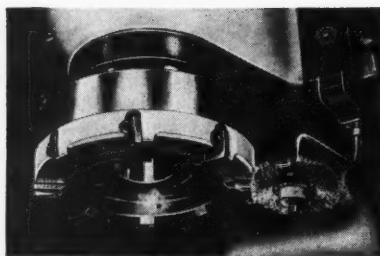
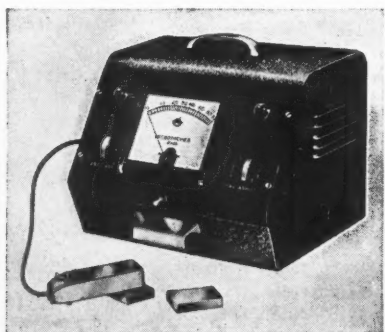
Tool for flaring soft copper, steel, aluminum, and brass tubing which automatically burnishes the face of the flare after it has been formed. This tool, announced by the Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7,



Ill., will make 45-degree flares on six sizes of tubing having outside diameters within the range of 3/16 to 5/8 inch for standard SAE flared fitting joints. The automatic burnishing action is provided through the use of a lost-motion mechanism in the yoke, which disengages the feed during the first revolution when backing off the cone. This causes the cone to burnish the flare, giving it a highly polished finish. With this tool the flare is formed directly above the flaring bar instead of against a bevel in the bar, so that the original thickness of the tubing is maintained.

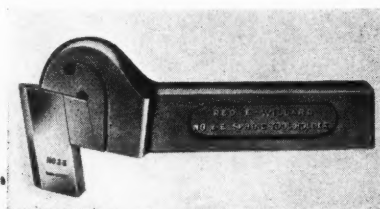
Surface Roughness Comparator

Portable electronic surface comparator designed to determine surface roughness at the production line. Announced by Kota-Meters, Inc., 2311 Burbank St., Dallas 19, Tex. This instrument has a roughness range of 1 to 100 micro-inches r.m.s. It evaluates the quality of a surface finish, indicating the index in micro-inches r.m.s. on a meter, the needle of which is arrested at the correct reading position. No visual or mental averaging is required. The probe of the instrument is held by hand, and is designed for use on radial, longitudinal, internal, and external surfaces.



Milling Cutter "Chip Remover"

"Chip Remover" seen cleaning the blades of a milling cutter. The device consists of a rotating wire brush on a magnetic base, which can be easily mounted on any horizontal or vertical milling machine and quickly removed. The wire brush, when placed in contact with the revolving teeth or blades of the cutter, serves to push off adhering chips, thus greatly prolonging the cutter life. Product of Detroit Milling Cutter Co., 28625 Grand River Ave., Farmington, Mich.

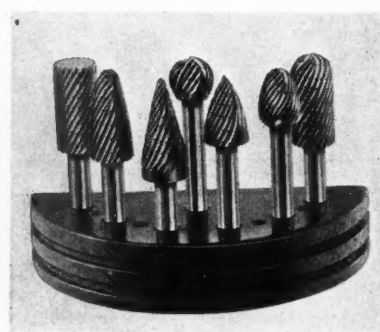


"Red-E" Spring Tool-Holder

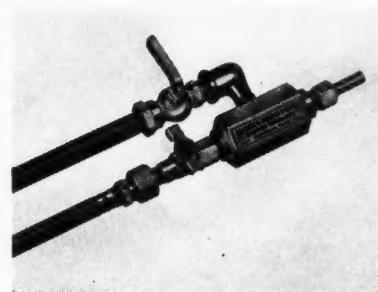
"Red-E" Willard spring tool-holder developed to permit threading close to a shoulder and to produce smooth, accurate threads. No fitting to gage is necessary when grinding, and no adjustment in the toolpost is needed after grinding. A wrench and special hardened high-speed steel cutter are supplied with the holder. Designed by Ready Tool Co., 554 Iranistan Ave., Bridgeport, Conn.

Severance "Midget Mills"

Set of seven 1/4-inch shank high-speed "Midget Mills" with 1/2-inch diameter cutting heads in wooden tool-block de-



signed for convenient storage and handling. These cutters are made of high-speed steel, and are said to cut fast and clean on a wide range of materials. Announced by Severance Tool Industries, Inc., 636 Iowa St., Saginaw, Mich.



New Lubricating and Coolant System

Milford "Atom-Lube" equipment designed to apply a newly developed system of cooling and lubricating to cutting tools. Can be effectively operated by either industrial air pressure lines or small air compressors. Its powerful air jet atomizes any cooling and lubricating liquid—from water to heavy machine oil. A flexible nozzle arrangement permits the vapor spray to be directed against the edge of the cutting tool at the most effective angle. Announced by the Henry G. Thompson & Son Co., New Haven 5, Conn.



"Capacitrol" Indicating Pyrometer Controller

Compact, direct-reading, indicating pyrometer controller incorporating a built-in unit to provide straight-line control. Made by Wheelco Instruments Co., 847 W. Harrison St., Chicago 7, Ill. This new Model 293 "Capacitrol" is designed to provide a proportioning control for processing equipment, such as ovens, furnaces, kilns, pots, vats, and plastic molding machines, heretofore only obtainable through the use of auxiliary devices or complicated equipment. It is 7 5/8 inches wide, 8 1/2 inches high, and 7 25/32 inches deep.

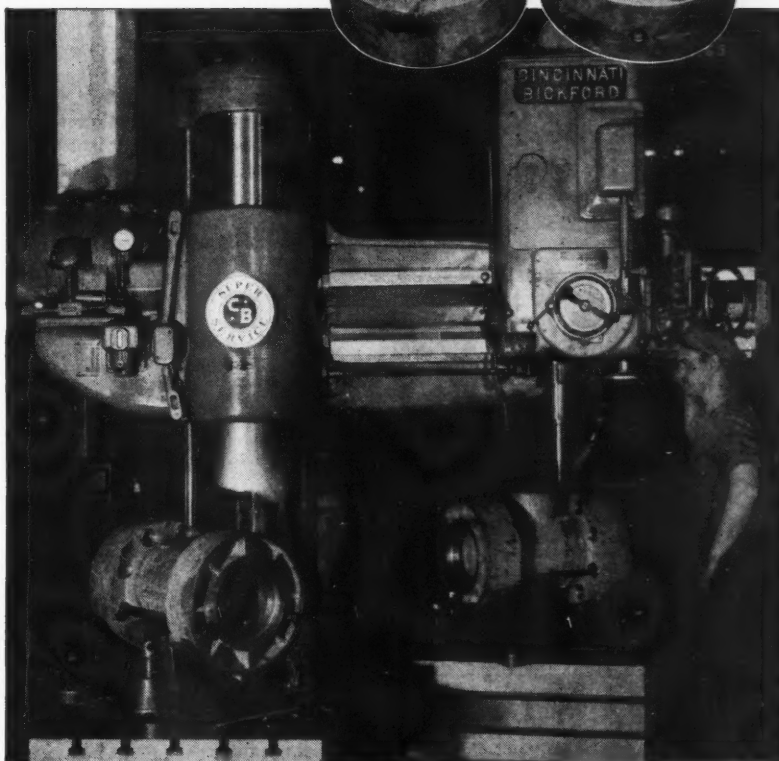
*saving 2½ hours
per piece.....*



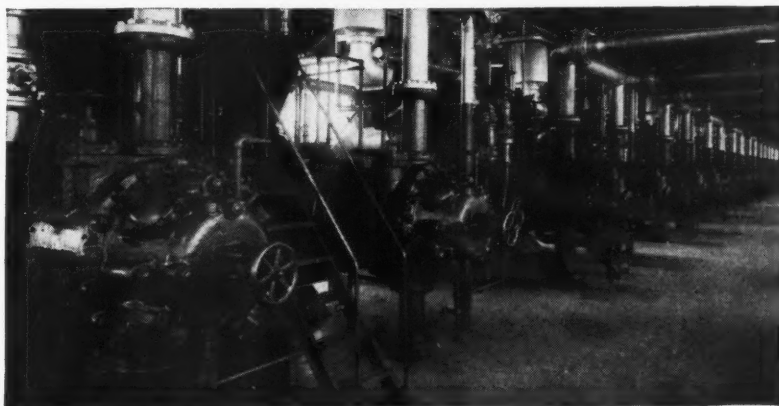
Profitable experience brings satisfaction—and so you find 33 Cincinnati Bickford Drills of all types at the Grove City plant and 20 at the Mt. Vernon plant of The Cooper-Bessemer Corporation.

In the steel compressor bodies shown, and in the front and rear heads which involve similar drilling operations, 1⅜", 2⅜", and 2⅞" holes are bored with a time saving over a previous machine of 2½ hours, floor to floor per unit.

Handling time was much reduced, and the outstanding convenience and ease of control, combined with steady, accurate performance and dependability, effect these marked operating savings.



One of the battery of Cincinnati Bickford Super Service Radial Drills at work on compressor cylinder bodies.



Ten Cooper-Bessemer Type GMV six-cylinder gas engines of The Cooper-Bessemer Corporation at work in a large Canadian oil company plant. A Cincinnati Bickford Super Service Radial worked on these compressor cylinders.

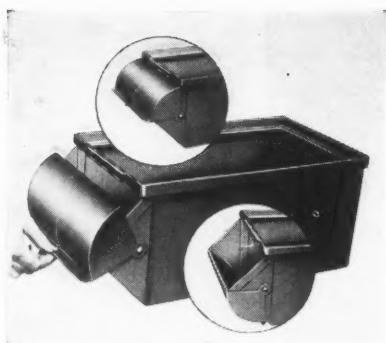
**CINCINNATI
BICKFORD**



RADIAL AND UPRIGHT DRILLING MACHINES

THE CINCINNATI BICKFORD TOOL CO.

Cincinnati 9, Ohio U.S.A.



Hooded "Stackbins" for Small Parts and Materials

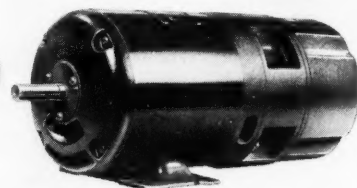
Hooded "Stackbin" designed to protect small parts and materials from dust and to permit handling, even on trucks or inclined conveyors, without spilling the

contents. The hood is securely fastened in the closed position by a positive latch, easily released by light finger pressure. These new "Stackbins" can be quickly stacked together in tiers for either storage or assembly. Standard sizes range from 3 1/2 by 6 by 3 1/4 inches to 15 by 24 by 11 inches. Manufactured by Stackbin Corporation, 1141 Main St., Pawtucket, R. I.

"Flex-Disc" Air Friction Clutch

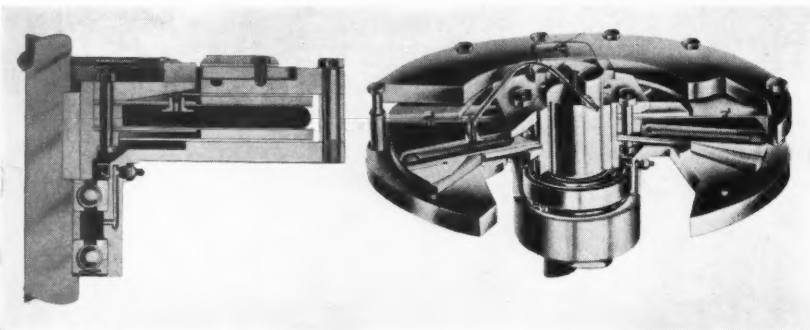
New "Flex-Disc" air-operated friction clutch for heavy-duty applications. This clutch is said to have no moving parts to wear and never to require adjustment. Also, it will not burn out, clog up, or become affected by oil or water. The clutch is of compact, alloy steel

construction, light in weight, and requires a minimum of shaft space. It is available in single and multiple tube and plate design. Manufactured in a full range of capacities and sizes. Air friction brakes of the same general design, either spring-engaged and air-released or air-engaged and spring-released, are also available. Announced by the Cardwell Mfg. Co., Inc., Clutch Division, Wichita, Kan.



Doerr Motor with Stearns Magnetic Brake

The illustration shows a 1/4-H.P. motor on Series 56 frame with integrally mounted Stearns magnetic brake, brought out by Doerr Electric Corporation, Cedarburg, Wis. Similar designs of motors are available with frames to and including the NEMA Series 254. Both open and enclosed motors can be furnished for either single- or three-phase service.



Metal-Cutting Conference to be Held at M.I.T.

A two-day technical conference on metal-cutting which will feature speakers of national reputation in this field will follow the dedication of the new Metals Processing Laboratory at the Massachusetts Institute of Technology on Tuesday, June 3. The new building was made possible by a gift of \$1,000,000 from Alfred P. Sloan, Jr., chairman of the board of General Motors Corporation.

The conference on metal-cutting, to be held on June 4 and 5, is being sponsored by the Machine Tool Division of the M.I.T. Department of Mechanical Engineering. There will be four sessions, occupying the morning and afternoon of each day, at which the following major themes will be discussed: Thermal Aspects of High-Speed Machining; Wear and Tool Life; Applications of Metal-Cutting Research to Machining Operations; and Mechanics of the Cutting Process.

Moderators for these sessions will be Professor Orlan W. Boston, chairman, Department of Production Engineering and Professor of Mechanical Engineering, University of Michigan; S. E. Knudsen, director, Process Development Section, General Motors

Corporation; Tell Berna, general manager, National Machine Tool Builders Association; and Dr. D. C. Drucker, Professor of Engineering, Brown University.

Among the technical papers that will be read the first day are: "Thermal Effects in the Shear Region," by Dr. Robert S. Hahn, Heald Machine Co.; "Temperature Measurements in a Work-Piece, Chips, and Tool," by Dr. Alfred O. Schmidt, Kearney & Trecker Corporation; "The Role of the Cutting Fluid in High-Speed Machining Operations," by Dr. Alfred G. Cattaneo and Stewart J. Beaubien, Shell Development Co.; "The Nature of Wear," by Charles D. Strang, director of research, Kiekhaefer Corporation; "Tool Wear as Influenced by Physical Properties of the Material Cut," by Dr. William W. Gilbert, Professor of Production Engineering, University of Michigan; and "The Importance of Jet Velocity in the Improvement of Tool Life with Cutting Fluids," by Bruce R. Walsh, research engineer, Gulf Research and Development Co.

The papers to be read on the last day are as follows: "Reducing Metal-

Cutting Research to Practice," by Dr. Max Kronenberg, consulting engineer, Cincinnati, Ohio; "Chip-Breakers—Theory, Experiment, Design," by Professor Erik K. Henriksen, Cornell University; "Residual Stresses in Machined Surfaces," by Professor E. G. Thomsen, University of California; "The Materials Aspects of the Cutting Process," by Dr. Egon Orwan, Professor of Mechanical Engineering, Massachusetts Institute of Technology; "The Mechanics of the Cutting Process," by Dr. M. Eugene Merchant, assistant director of research, Cincinnati Milling Machine Co.; and "Influence of Chip Stress on the Mechanics of the Simple Shearing Process," by Dr. Bernard W. Shaffer, New York University.

Following the presentation of the prepared papers, the moderator and speakers of each session will constitute a panel for the discussion of comments and questions. Abstracts of comments and questions relevant to particular topics may be submitted in advance to the conference chairman, Professor Milton C. Shaw, Room 1-233, Massachusetts Institute of Technology, Cambridge 39, Mass.



Between Grinds

By E. S. Salichs

Once More, Please!

Inquiries made on March 17 and 18 at the Pratt & Whitney booth during the A.S.T.E. Show in Chicago went up in smoke, the result of the fire which destroyed their display. (Did a descendant of the famous Chicago cow that kicked the lantern wander over from Mrs. O'Leary's barn?) P & W is anxious to supply the literature or information that visitors had requested on those days—so if you were and did, send a duplicate request to Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn., or to any nearby branch office.

Measure Our Pleasure

"Inspection and Gaging," The Industrial Press book published October 31, 1951, was included in the 100 Best Technical Books of 1951—the selection made yearly by R. R. Hawkins, chief of the Science and Technology Department, New York Public

Library. Author of the book, Clifford W. Kennedy, is himself an expert on quality—he's quality control engineer for the Federal Products Corporation.

Money in the Barrel, Or You Too Can Win \$1000

Pangborn Corporation is offering that o-so-round sum for a suitable name for their new Rotoblast Barrel. This airless blast cleaning machine is on view at the Atlantic City Foundry Congress. However, you don't have to sniff an ocean breeze to clear the brain and send in a name—but be not later than midnight, son, May 24—to Pangborn Corporation, 1400 Pangborn Blvd., Hagerstown, Md.

California Comes East

Other day, chap arrived in office to tell the Editor: "I'm the president of the Magna Engineering Corporation, Menlo Park, Calif. Have a truck downstairs

with our equipment in running order and would like you to see it in action." Editor clapped his hat on his head, off to see this novel demonstration. There on our busy thoroughfare a moving van was parked; on the van was installed drilling machines designed for right- and left-hand operators. Power was supplied by a generator.

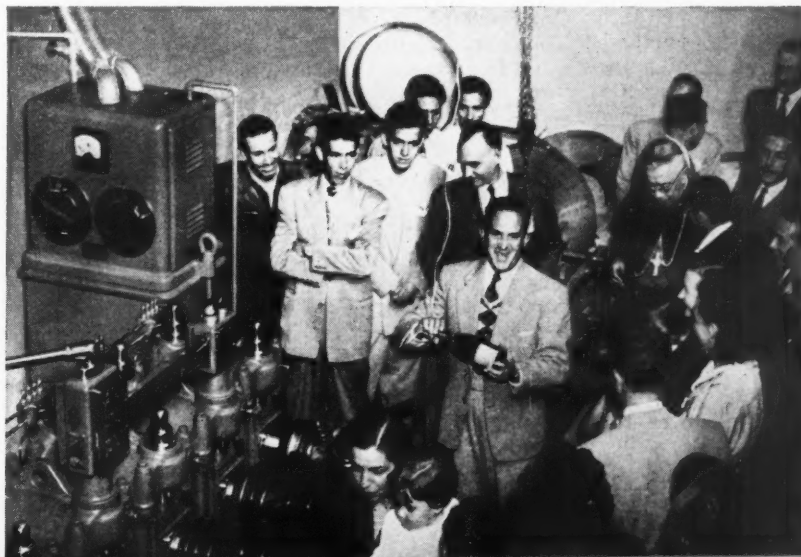
Clearing the Air

A room air-conditioner professes to remove stuffiness. The "stuffiness," however, is limited to smoke and stale air—the device has no power over the conference room repartee.

Testing? No, Staying

From 1902 when the American Society for Testing Materials was incorporated in Pennsylvania until today, there have been only two secretaries—Edgar Marburg, until 1918, and C. L. Warwick, 1919 till now.

OLLA, OLLA!—A tube mill manufactured by the American Electric Fusion Corporation, Chicago, Ill., being installed at Muebles Briones, Mexico City makers of tubular furniture. The celebration is according to Don Hoyla. Company officials and their families, including the young fry, witness the solemn benediction by the Archbishop of Mexico. Then the new machine is christened, a bottle of champagne being broken over its noggin. A high government official presses the starting button of the mill, the town streams in to enjoy open house, and Viva — another step is taken in the modernization of Mexican industry.



News

OF THE INDUSTRY

California and Washington

AMERICAN BRAKE SHOE CO., New York City, has purchased a plant formerly owned by the JUMBO STEEL CO., Azusa, Calif. The American Forge Division of the American Brake Shoe Co. will use the plant to start a West Coast steel forging operation.

STERLING ELECTRIC MOTORS, INC., Los Angeles, Calif., has opened two new sales offices—one at 319 Castle Blvd., Tulsa, Okla., with B. G. JORDAN as manager, and the other at 63 Liston Road, Buffalo 17, N. Y., with J. W. BYRNES in charge.

LAWRENCE M. LIMBACH has been appointed works manager of the Ryan Aeronautical Co., San Diego, Calif. Mr. Limbach was formerly associated with the Republic Steel Corporation, Cleveland, Ohio.

WARD LEONARD ELECTRIC CO., Mount Vernon, N. Y., announces that the Los Angeles branch has moved to new headquarters at 1605 E. Olympic Blvd., Los Angeles 21, Calif.

ALEX REIKES has become manager of the San Francisco, Calif., branch of Graton & Knight Co., Worcester, Mass., manufacturer of industrial leather products.

SEATTLE CHAIN & MFG. CO., Seattle, Wash., has changed its name to ROUND SEATTLE CHAIN CORPORATION, in order to identify the company with the nation-wide Round Chain organization.

Connecticut and Massachusetts

WALTON CO., Hartford, Conn., has purchased the manufacturing rights of a tool-holder from the American Stay Co., East Boston, Mass. The tool-holder is now to be known as the Walton-American tool-holder.

JUSTICE LOCKWOOD has been appointed vice-president in charge of sales of the American Brass Co., Waterbury, Conn. Mr. Lockwood was formerly manager of the Buffalo, N. Y., branch of the company.

RALPH S. HOWE, executive vice-president of the New Britain Machine Co., New Britain, Conn., is taking over the duties of Director of the



Ralph S. Howe, director of the Metal-Working Equipment Division, National Production Authority

Metal-Working Equipment Division of the National Production Authority, United States Department of Commerce. Mr. Howe has been granted a six months' leave of absence by the company, and also by the National Machine Tool Builders' Association of which he is a director, in order to make this "tour of duty" in Wash-



Justice Lockwood, new vice-president in charge of sales of the American Brass Co.

ington, D. C. He succeeds SWAN E. BERGSTROM, who is returning to his post of vice-president of the Cincinnati Milling Machine Co.

CHARLES R. CROWDER, vice-president and general manager of the Van Norman Co., Springfield, Mass., was recently elected first vice-president and a member of the board of directors.

DAVID S. WILLIAMS has been elected president of the Graton & Knight Co., Worcester, Mass., succeeding his father, ARTHUR A. WILLIAMS, who is now chairman of the board.

SYLVANIA ELECTRIC PRODUCTS, INC., New York City, will soon open a new plant at Woburn, Mass., to be headquarters for their Electronics Division.

Illinois and Indiana

AMERICAN MACHINE & FOUNDRY CO., New York City, has purchased the THOMPSON-BREMNER CO., Chicago, Ill., manufacturer of industrial fasteners and electrical terminals. The Chicago concern will become a subsidiary and will be operated as part of the General Products Division of the American Machine & Foundry Co. HENRY T. CHAMBERLAIN will remain president of the new subsidiary.

JAMES SUTTIE, vice-president of American Steel Foundries, Chicago, Ill., was presented with the Lorenz Memorial Gold Medal at the Fiftieth Anniversary meeting of the Steel Founders' Society in Chicago, Ill. The Lorenz Gold Medal was established by the Society in 1938 as an award for outstanding service to the steel casting industry.

NELSON W. DEMPSEY, assistant manager of operations, has been promoted to manager of operations of the Chicago district of American Steel and Wire Division, United States Steel Corporation, Cleveland, Ohio. Mr. Dempsey has been with the company since 1917.

POWDERED METAL PRODUCTS CORPORATION OF AMERICA, Franklin Park, Ill., recently elected CARL G. LEVIN, M. W. ISAACSON, and C. CHANDLER COLE vice-presidents of the corporation. They are also secretary, sales manager, and comptroller, respectively.

ROBERT C. BECHERER has been elected president of the Link-Belt Co., Chicago, Ill., succeeding GEORGE



MORE THAN 300 PARTS ARE MACHINED with the aid of *one* cutting oil for tools and hardware items made by Sargent & Co. Raw materials worked are: B1113 steel, 11ST-3 aluminum, ASTM-B140-46 Type B half-hard bronze, B16-46 brass, and Type 416 stainless steel. Stock ranges from $\frac{1}{16}$ " wire to 2" bars.

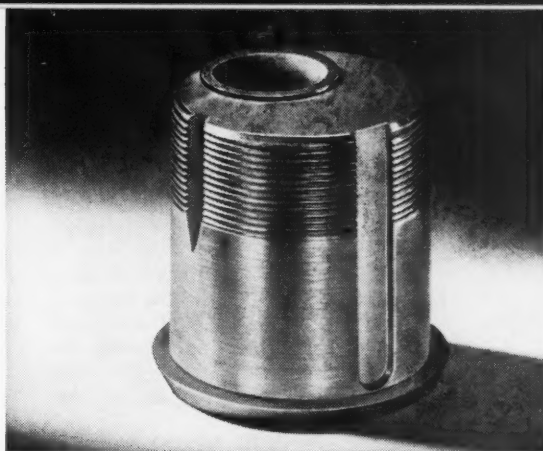
SINGLE GRADE OF SUNICUT REPLACES 4 CUTTING OILS

A good example of cutting-oil economy and efficiency is provided by Sargent & Co., well-known hardware and tool manufacturers. Their complete line requires the machining of more than 300 parts from a wide range of metals. A few years ago this company was using four different cutting oils, purchased in drums. By switching to a single product, Sunicut 11W, and buying it in bulk, Sargent has been able to effect an annual saving of about \$3,000. All operations are performed as well as before, or better—and shop efficiency is up.

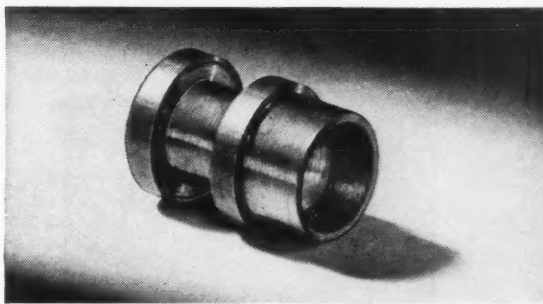
Sunicut 11W is a low-viscosity, dual-purpose cutting oil for automatics machining all nonferrous metals and free-machining steels such as B1112 or B1113. Its transparency permits quick and accurate miking. It will not stain brass or copper under normal conditions. It drains rapidly, minimizing carry-off. And its high lubricating and cooling properties aid in prolonging tool life and improving finishes. Moreover, it protects finished parts from rust and corrosion.

Other Sun cutting oils offer similar opportunities for improved operations and economy. For information about them, or the help of a Sun representative, use the coupon at the right.

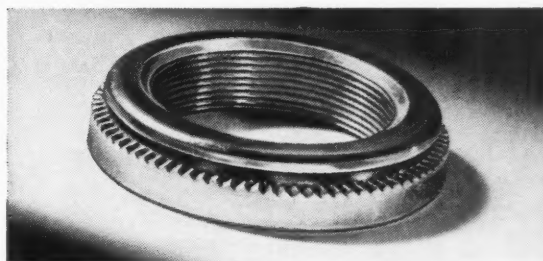
SUN INDUSTRIAL PRODUCTS
SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO & MONTREAL



LOCK CYLINDER. Metal: $1\frac{1}{8}$ " dia. brass
• Machine: model 601 New Britain Gridley
• Operations: *crossslide*—rough form, finish form, break down cut off, side mill, vertical end mill, final cut off; *tool slide*—face, drill offset hole, ream and counterbore offset hole, thread
• Spindle Speed: 1,324 rpm • Feed: .006" per revolution • Tools: high-speed steel • Cycle Time: 7.3 seconds



CARPENTER'S PLANE PART. Metal: $\frac{3}{8}$ " B1113 steel • Machine: Brown & Sharp Automatic Screw Machine • Operations: *front cross slide*—form; *rear cross slide*—cut off; *turret*—feed stock, spot drill, drill $\frac{1}{8}$ " hole, tap drill, reverse spindle and tap left-hand thread
• Spindle Speed: 1,180 rpm • Feed: .0025" per revolution • Tools: high-speed steel • Cycle Time: 30 seconds



KNOB INSERT. Metal: $1\frac{1}{8}$ " round aluminum
• Machine: model 61 $1\frac{1}{8}$ " New Britain Gridley
• Operations: *cross slide*—form, knurl, cut off; *tool slide*—spot drill, tap, ream, recess • Spindle Speed: 1,600 rpm • Feed: .005" per revolution • Tools: high-speed steel • Cycle Time: 7 seconds

SUN OIL COMPANY, Dept. M-5.
Philadelphia 3, Pa.

I am having trouble possibly caused by an inadequate cutting oil. I would like ☐ the services of a Sun representative; ☐ the booklet "Cutting and Grinding Facts."

Name

Title

Company

Street

City Zone State

P. TORRENCE who has retired. Mr. Becherer has been with the company since 1923, and was executive vice-president at the time of his election.

BARBER-COLMAN Co., Rockford, Ill., has purchased the WHEELCO INSTRUMENTS Co., Chicago, Ill., manufacturer of indicating, recording, and controlling industrial instruments. At present, operations will continue at the Chicago plant.

KAUFMAN MFG. Co., Manitowoc, Wis., has appointed the FOUR STATES MACHINERY Co., representative for Kaufman products. The Four States Machinery Co. is located at 5304 W. Chicago Ave., Chicago, Ill.

HARRY ANKENNEY has been made works manager of the Chicago plant of Verson Allsteel Press Co., Chicago, Ill. Mr. Ankeney was plant engineer at the time of his promotion.



Harry Ankeney, new works manager of the Verson Allsteel Press Co.

THOMAS A. JONES was recently elected president of the W. A. Jones Foundry & Machine Co., Chicago, Ill., while FREDERICK H. HOGE was made chairman of the board.

ARTHUR H. NELSON was recently made manager of electric tool sales at Chicago for the Independent Pneumatic Tool Co., Aurora, Ill.

KROPP STEEL Co. has opened a Chicago district office at 5301 W. Roosevelt Road, Chicago 50, Ill.

CHRISTIANSSEN CORPORATION, Chicago, Ill., producer of aluminum and magnesium alloy ingot and other products for the foundry, has formed a wholly-owned subsidiary, named TITANIUM Co. OF AMERICA. The new company will be located in East Chicago, Ind., and will manufacture wrought products from titanium.

G. DONALD CAMPBELL has been appointed superintendent, and JOHN A. McMILLAN plant engineer, of the Shelbyville, Ind., plant of the Pittsburgh Plate Glass Co., Pittsburgh, Pa. This plant was recently purchased by the company for the production of fiber glass.

Michigan

PERFECT CIRCLE CORPORATION, Hagerstown, Ind., has purchased the CENTRIFUGAL FOUNDRY Co., Muskegon, Mich., which will become a subsidiary of the corporation. W. B. PROSSER, vice-president and general manager of the Perfect Circle Corporation, is president of the new subsidiary.

L. B. KRUSE has been appointed district manager of the Detroit, Mich., office of Kurt Orban Co., Inc., New York City, distributor of German-made machine tools and parts. The Detroit office is located at 19450 James Couzens Highway.

W. E. MASSEY, vice-president and sales manager of Weldit, Inc., Detroit, Mich., has been elected president of the company. JOSEPH SMITH, formerly sales manager, is now vice-president in charge of production.

ROBERT C. COLYER has become manager of Elbeeco, Inc., subsidiary of the Aeroquip Corporation, Jackson, Mich. Elbeeco, Inc., manufactures elbow type hose fittings for the parent company, at Jackson.

JAMES H. FERGUSON has been made branch manager of the newly opened Detroit, Mich., office of Strong, Carlisle & Hammond Co., Cleveland, Ohio. The office is located at 18133 James Couzens Highway.

HEPPENSTALL Co., Pittsburgh, Pa., has appointed EDGAR L. FINK Co., 6911 E. Lafayette Ave., Detroit, Mich., to handle the sale of its metal cutting knives in Wayne County, Mich.

A. MILNE & Co., New York City, tool steel distributors, have opened a sales office at 915 Fisher Bldg., Detroit 2, Mich. W. T. NAGORSEN will be in charge.

R. L. SCHMITT Co., manufacturer of carbide tools, announces its removal from Wyandotte to a new plant at 6536 Roosevelt, Allen Park, Mich.

EDWARD N. TISDALE has been appointed director of industrial relations of the Pioneer Engineering & Mfg. Co., Detroit, Mich.

New Jersey

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J., has changed its name to the WORTHING-

TON CORPORATION. Because the corporation has extended its manufacturing activities into many other fields besides pump manufacture, the change in the corporate name was deemed expedient.

WILLARD P. CUNNINGHAM has been made director of engineering sales for L. O. Koven & Brother, Inc., Jersey City, N. J., manufacturers of tanks, mixers, and boilers.

NORMAN A. MATTHEWS has been named assistant chief metallurgist by the American Brake Shoe Co., New York City, in its metallurgical research department at Mahwah, N. J.

WENDELL P. MCKOWN, JR., has joined the Cooper Alloy Foundry Co., Hillside, N. J., in the capacity of works manager.

New York

GENERAL ELECTRIC Co., Schenectady, N. Y., announced several promotions recently, as follows: In the Turbine Division, ALAN HOWARD has been made manager of the engineering department; and JOHN P. KELLER has been named general manager of the gas turbine department. In the company's newly formed industry control department, WILLIAM F. OSWALT has become manager of manufacturing; and HAL W. POOLE has been appointed manager of engineering.

HYDROPRESS, INC., is moving from 570 Lexington Ave. to the Empire State Bldg., 350 Fifth Ave., New York 1, N. Y. The company's Rolling Mill Division, located at 139 E. 56th St., and the LOEWY CONSTRUCTION Co., Inc., a wholly owned subsidiary, now at 216 E. 49th St., both of New York City, will also occupy the new quarters of Hydropress, Inc.

E. W. BLISS Co., Canton, Ohio, announces the opening of a branch office at 50 Church St., New York 7, N. Y. The territory represented will include southeastern New York State, northern New Jersey, and northeastern Pennsylvania. L. R. HILLS has been appointed district sales manager in charge of the office.

TOCCO DIVISION OF OHIO CRANK-SHAFT Co., Cleveland, Ohio, has appointed the COSA CORPORATION, New York City, sales representative in the Far East. FRANK NOBU is Japanese representative for the Cosa Corporation. Mr. Nobu is president of Kaigai Tsusho K. L., (a Cosa affiliate) Marunouchi Building, Tokyo, Japan.

CLYDE W. SMITH, U.S.N. Ret., has just been appointed assistant to the president of Kollsman Instrument Corporation, Elmhurst, N. Y., manufacturer of precision aircraft and optical instruments. Admiral Smith

was formerly Director of the Airborne Equipment Division at the Navy Bureau of Aeronautics.

ROBERT W. KISE has been named manager of product planning for the industrial heating department of the General Electric Co., Schenectady, N. Y. Until his present appointment, Mr. Kise was manager of sales for the department's industrial heaters and devices section.

WALTER KIDDE NUCLEAR LABORATORIES, INC., has been organized in New York City with the primary objective of developing commercial atomic power. It is an associate of other Kidde enterprises. Dr. KARL COHEN will direct technical activities of the laboratories.

CARL HIRSCHMANN Co., Manhasset, N. Y., has been appointed representative for EBOSA, S. A., Grenchen, Switzerland, manufacturer of turning and thread chasing machines, hardness testers, and measuring machines.

ROYAL METAL MFG. Co., Chicago, Ill., has formed a division to be known as the ROYAL-WALDEN CORPORATION, occupying a plant at Walden, N. Y. GAYLORD WEBSTER has been named general manager.

RALPH DOMES has become head of the new Syracuse, N. Y., sales engineering office of Winsmith-Buffalo, Buffalo, N. Y., manufacturers of industrial transmission equipment.

LEO P. SINCLAIR has been appointed field engineer for the Daco Machine & Tool Co., Brooklyn, N. Y., manufacturer of precision instruments.

LEE FRASER has become production manager of the Arma Corporation, Brooklyn, N. Y.



Garvin A. Drew, newly appointed assistant vice-president of the Scovill Mfg. Co., Inc.

GARVIN A. DREW has been appointed assistant vice-president of the Scovill Mfg. Co., Inc., in charge of the Schrader Division, Brooklyn, N. Y. He will continue in his capacity as general sales manager.

Ohio

EDWIN M. MILLER has been made plant superintendent of the Machine Division for the Lincoln Electric Co., Cleveland, Ohio. Mr. Miller has been head of the production control department for the last ten years. The company also announced the election of J. S. ROSCOE and G. E. TENNEY to the board of directors. Mr. Roscoe is director of purchasing, while Mr. Tenney is service manager.

YODER Co., Cleveland, Ohio, manufacturer of electric-weld tube mills and cold-roll forming and slitting machinery, has opened an office at 11 W. 42nd St., New York City. ROBERT H. BRINKER is in charge of the office which will handle sales in New England, southern New York, and Atlantic Coast territory down to and including Washington, D. C.

A. F. KOCH has been named works manager of the Wooster Division, Wooster, Ohio, of the Borg-Warner Corporation, Chicago, Ill. Mr. Koch had been manager of the Norge Division's plant at Chattanooga, Tenn., previous to his transfer.

HENRY M. KIDD has been appointed vice-president of the Spray Painting Equipment Division of the DeVilbiss Co., Toledo, Ohio. Mr. Kidd was sales manager of the Division at the time of his promotion.

DALE D. DROLLINGER has been appointed to the sales application engineering staff of the Cincinnati, Ohio, office of Reliance Electric & Engineering Co., Cleveland, Ohio.

JOHN H. BUTCHER was recently elected president of the Butcher & Hart Mfg. Co., Toledo, Ohio, manufacturer of lock washers.

R. K. COMPTON has been named director of industrial relations by E. W. Bliss Co., Canton, Ohio.

Pennsylvania and Maryland

HAROLD F. GADE, one of the founders of Standard Pressed Steel Co., Jenkintown, Pa., retired recently after forty-nine years of service. At the time of his retirement he was senior vice-president and treasurer.



(Left) Edwin M. Miller, plant superintendent of the Machine Division, Lincoln Electric Co. (Center) J. S. Roscoe, director of purchasing, and (Right) G. E. Tenney, service manager, who have been appointed to the board of directors

His son, **GEORGE A. GADE**, who is field sales manager, was elected to the board of directors.

CARPENTER STEEL Co., Reading, Pa., has promoted the following assistant branch managers to the position of branch manager: **A. RICHARD BOYD**, Atlanta, Ga.; **W. J. ERVIN**, Indianapolis, Ind.; **W. C. KUNKELMAN**, Cincinnati, Ohio; **H. M. RITTGER**, St. Louis, Mo.; and **R. P. UHL**, Dayton, Ohio.

NIAGARA MACHINE & TOOL WORKS, Buffalo, N. Y., manufacturers of presses, shears, and other sheet metal-working machines and tools, announce the opening of a Philadelphia district office at 50 E. Wynnewood Road, Wynnewood, Pa. **JOSEPH J. ORTALI** has been appointed district manager.

JOHN E. NEWLIN, JR., has become sales manager of the Steel Division of **Henry Disston & Sons, Inc.**, Philadelphia, Pa., manufacturers of saws, tools, and special alloy steels. Mr. Newlin succeeds **H. D. SIEGFRIED**, who recently retired.

C. W. MARTIN has been appointed die sales and service engineer in the Pittsburgh, Pa., office of the Carboly Department of **General Electric Co.**, Detroit, Mich. He succeeds the late **R. R. PRESTON**.

FRANK G. TUEBK has been promoted from general superintendent to the position of works manager of the Coraopolis, Pa., plant of the **Pittsburgh Forgings Co.**

R. A. BOWMAN has been made plant manager of the Berry Division of the **Oliver Iron & Steel Corporation**, Pittsburgh, Pa.

PITTSBURGH PLATE GLASS Co., Pittsburgh, Pa., recently opened a new plant in Baltimore, Md., for the manufacture of industrial brushes. The plant, located at 3201 Frederick Ave. in Baltimore, provides an additional manufacturing space of 21,000 square feet for the company's Brush Division.

WILLIAM C. VAN CLIEF, JR., has joined the **Pittsburgh Plate Glass Co.**, Pittsburgh, Pa., in the capacity of manager of the company's new power-driven brush factory located at Baltimore, Md.

Texas, Tennessee, Kentucky, and Missouri

CLECO DIVISION OF THE REED ROLLER BIT Co., Houston, Tex., manufacturer of air drills and accessories, has announced the appointment of the following distributors: **BRISTOL METAL WORKING EQUIPMENT Co.**, 534 Front St., Hartford, Conn.; **S & M SUPPLY Co.**, 761 S. Seventh St., Grand Junc-

tion, Colo.; and **QUINN WELDING SUPPLY CENTER**, 2725 Chicago Road, Chicago Heights, Ill.

A. A. PRICE has been appointed sales manager of the Nashville, Tenn., office of the **Solar Steel Corporation**, New York City. The Nashville office, located at 500 Second Ave., South, will supply flat-rolled and bar and



A. A. Price, sales manager,
Nashville office of the Solar
Steel Corporation

tube products in Tennessee, Alabama, Louisiana, Mississippi, North and South Carolina, Georgia, and Florida.

REYNOLDS METALS Co., Louisville, Ky., recently announced the appointment of the following distributors: **VINSON SUPPLY Co.**, 3331 Haggard Drive, Dallas, Tex., and **VORY'S BROS., Inc.**, 65 E. Goodale St., Columbus 8, Ohio—both to handle the company's line of aluminum mill products; and **G. A. AVRIL SMELTING CORPORATION**, Este Ave. and B. & O. Railroad, Cincinnati, Ohio, to handle the distribution of ingot products.

AMPCO METAL, INC., Milwaukee, Wis., has appointed **KIRK-WICKLUND & Co.**, Kansas City, Mo., distributor for the northern and eastern section of Kansas, handling the complete line of Weldrod products.

Wisconsin

W. J. SPARLING, vice-president and manager of the Chain and Transmission Division, was recently appointed to the newly created position of vice-president and manager of Milwaukee operations for the **Chain Belt Co.**, Milwaukee, Wis. **M. G. JEWETT** was appointed manager of the Chain and Power Transmission Division of the company. Mr. Jewett was chief engineer of the Division prior to his promotion.

DONALD E. BEATON has been made assistant general manager of the Hydraulic Division, Rockford, Ill., of the **Twin Disc Clutch Co.**, Racine, Wis. The company also announced the opening of its enlarged branch factory at 15 Fenwick St., Newark, N. J., and of a new factory branch in Dallas, Tex.

J. D. GREENSWARD has been named manager of the newly organized apparatus department at **Allis-Chalmers Mfg. Co.**, Milwaukee, Wis. Mr. Greensward will also continue as general manager of the company's **Norwood Works**.

RACINE TOOL & MACHINE Co., Racine, Wis., has changed its name to **RACINE HYDRAULICS & MACHINERY, INC.** Announcement was also made that the company has moved from 1760 State St. to 2000 Albert St., in Racine.

WISCONSIN DRILL HEAD Co., manufacturer of standard and special drill heads, has moved from Milwaukee to Butler, Wis.

JACK B. GRIESER has joined the sales staff of the **Metal Spraying Corporation**, Milwaukee, Wis.

* * *

International Standards for Ball and Roller Bearings

A world-wide system of standards for ball and roller bearings will be discussed by international standardization experts from twelve countries, who are to meet in New York City for a ten-day session beginning June 16. The meetings are to be held at **Columbia University** in conjunction with the second triennial General Assembly of the thirty three nation **International Organization for Standardization**.

The nations participating are Austria, Czechoslovakia, France, Germany, Italy, Poland, Rumania, Sweden, Switzerland, United Kingdom, United States, and the U.S.S.R. The ISO project seeks to standardize terminology and definitions of bearings and bearing parts; nominal dimensions and tolerances of ball and roller bearings affecting their assembly with other machine parts; methods of inspection; methods of evaluating load ratings; and dimensions of mounting accessories.

Also on the agenda are the United States proposal for standardized taper roller bearings in inch dimensions and a request from Switzerland for consideration of their standards for a series of new miniature ball bearings for use in clocks.

The bearings standards work is being carried on by **ISO Technical Committee 4, Ball and Roller Bearings**. **Dr. Hilding Tornebohm**, head of the Swedish delegation, will preside.

SIDNEY

HEAVY DUTY LATHES

**SOLVE
YOUR
PRODUCTION
PROBLEMS**

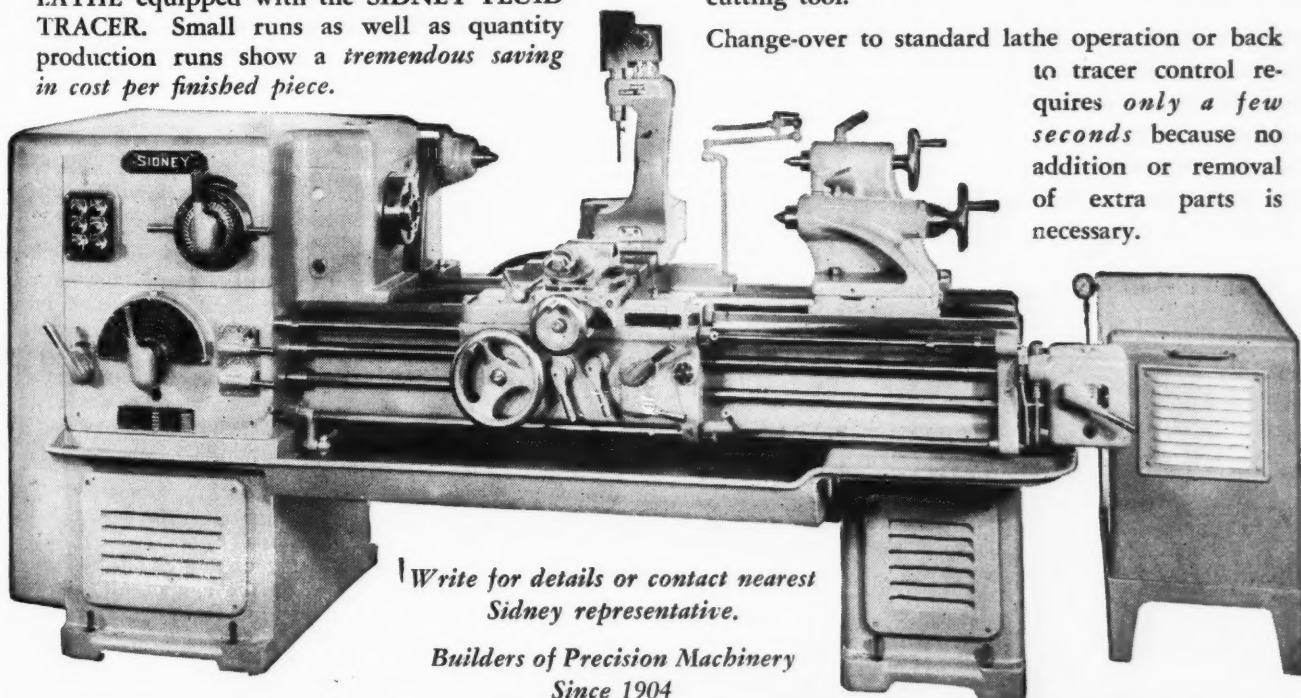


TURN ANY SHAPE.. ANY NUMBER.. FASTER.. MORE ECONOMICALLY

THE variety of shapes and sizes illustrated shows the versatility of the **SIDNEY LATHE** equipped with the **SIDNEY FLUID TRACER**. Small runs as well as quantity production runs show a *tremendous saving in cost per finished piece.*

The sensitive tracer head transfers every change in contour of the master piece or template to the cutting tool.

Change-over to standard lathe operation or back to tracer control requires *only a few seconds* because no addition or removal of extra parts is necessary.



*Write for details or contact nearest
Sidney representative.*

*Builders of Precision Machinery
Since 1904*

SIDNEY MACHINE TOOL COMPANY • SIDNEY, OHIO

Coming Events

MAY 1-7 — International Foundry Congress and Show at Convention Hall, Atlantic City, N. J. Sponsored by the AMERICAN FOUNDRYMEN'S SOCIETY, 616 S. Michigan Ave., Chicago 5, Ill.

MAY 5-16—BRITISH INDUSTRIES FAIR at London and Birmingham, England. For further information, write to British Information Services, 30 Rockefeller Plaza, New York 20.

MAY 8-9 — Methods and Measurement Clinic and National Convention of the AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS, sponsored by the Dayton Chapter of the Institute, in Dayton, Ohio. Further information can be obtained from R. E. Allen, Univis Lens Co., 401 Leo St., Dayton 1, Ohio.

MAY 14-16—National spring meeting of the SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS at the Lincoln Hotel, Indianapolis, Ind. Further information can be obtained from V. H. McNeilly, Purdue University, Lafayette, Ind.

MAY 22-24 — Sixth annual convention of the AMERICAN SOCIETY FOR QUALITY CONTROL at the Onondaga County War Memorial, Syracuse, N. Y. Further information can be obtained by addressing the Society at Room 5036, 70 E. 45th St., New York 17, N. Y.

MAY 30-31—Southwest Area Technical Meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS, in Dallas, Tex. For further information, write to V. V. Koodroff, Tool Supervisor, Chance-Vought Aircraft Co., Dallas.

JUNE 2-4 — Annual meeting of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at the Homestead, Hot Springs, Va. Executive secretary, John C. Sears, Empire Bldg., Pittsburgh 22, Pa.

JUNE 9-26 — Triennial meeting of the INTERNATIONAL ORGANIZATION FOR STANDARDIZATION at Columbia University, New York City. June 11-14, meeting of the Screw Threads Committee of the ISO. June 16-26, ISO Technical Committee 4 meeting, Ball and Roller Bearings. Headquarters American Standards Association, 70 E. 45th St., New York 17, N. Y.

JUNE 23-27 — Fiftieth anniversary meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotels Statler and New Yorker in New York City. Further information can be obtained from the executive secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.

SEPTEMBER 8-10 — THIRD NATIONAL STANDARDIZATION CONFERENCE sponsored by the American Standards Association in Chicago, Ill. Headquarters, Museum of Science and Industry. Further information can be obtained from the Association, 70 E. 45th St., New York 17, N. Y.

OCTOBER 20-24—NATIONAL METAL EXPOSITION AND CONGRESS at the Philadelphia Convention Hall, Philadelphia, Pa. Secretary, W. H. Eisenman, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

NOVEMBER 19—Thirty-fourth annual meeting of the AMERICAN STANDARDS ASSOCIATION at the Waldorf-Astoria in New York. Headquarters of Association, 70 E. 45th St., New York City.

* * *

Carbide Information for Shell Manufacturers

Companies producing shells will be interested in learning of the new Carbide Cutting Tool Sub-committee of the American Ordnance Association's Shell Committee of the Rocket, Bomb, and Artillery Ammunition Division.

All known technical data on applications of carbides in shell manufacture already have been reviewed by the sub-committee and are available to shell producers from the American Ordnance Association, 705 Mills Bldg., Washington 6, D. C. Additional bulletins and other pertinent material are being made available as rapidly as they are reviewed.

The chairman of the sub-committee is J. S. Gillespie, Carboly Department, General Electric Co., Detroit, Mich. Membership includes P. E. Floyd, Allegheny Ludlum Steel Corporation; M. E. Backstrom, Firth Sterling Steel & Carbide Corporation; Bennett Burgoon, Kennametal, Inc.; R. T. Beeghly, Metal Carbides Corporation; H. W. Highriter, Vascoloy-Ramet Corporation; W. N. Howley, chairman, A.O.A. Shell Committee.

* * *

Revised Procurement Manual Helpful to Contract-Seekers

Five thousand items and classes of items for which Federal agencies are in the market, a military agency index, a civilian agency index, and a list of the locations of the appropriate procurement offices make up the newly revised Government Procurement Manual of the U. S. Department of Commerce. The Manual, compiled by the Office of Small Business in the NPA, is being placed in Department of Commerce field offices throughout the country and in local Chambers of Commerce, where it can be consulted by businessmen interested in obtaining Government contracts.

Obituaries

George McGregor Morris

George McGregor Morris, chairman of the board of the Morris Machine Tool Co., Cincinnati, Ohio, died in Cincinnati on March 26, at the age of eighty-two years. Mr. Morris had been president of the Morris Machine Tool Co., manufacturer of radial drills and high production drilling, tapping, and reaming machinery, and of the John B. Morris Foundry, now out of business, both concerns having been founded by his father, John B. Morris. He retired in 1935 as president of the Morris Machine Tool Co., but retained an active interest in the company. Mr. Morris was well known throughout the machine tool industry.

Fred R. Daniels

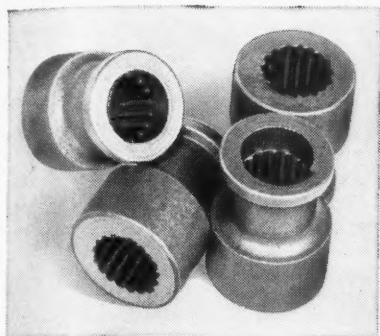
Fred Raymond Daniels, advertising manager of the Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn., died in Waterbury on April 7 after a long illness, at the age of sixty-five years. Mr. Daniels was in charge of Waterbury-Farrel advertising for twenty-nine years. Before joining the company, he was a member of the editorial staff of MACHINERY. Prior to this connection, he was associated with the Draper Corporation, Hopedale, Mass.

During World War II, Mr. Daniels inaugurated and edited the FARRELLITE, company house organ which was sent to employees in the service. Also he was one of the founders of the Industrial Advertising and Marketing Council, Western New England, chapter of the National Industrial Advertising Association. Mr. Daniels was well known in industrial advertising circles. He is survived by his wife, two sons, and daughter.

MAYNARD O. HALLIWILL, employment manager for the Cleveland Pneumatic Tool Co., Cleveland, Ohio, died on March 31 at the Cleveland Clinic, at the age of forty-five years. Mr. Halliwill was associated with the company for the last sixteen years, and was employment manager since 1942. He is survived by his wife.

ARNOLD C. HACKSTAFF, manager of the Denver district sales office for the Youngstown Sheet & Tool Co., died suddenly on March 25 at Denver, Colo., at the age of fifty-seven years. Mr. Hackstaff, a native of Denver, joined the company in 1919 and had been manager of the Denver office since 1928.

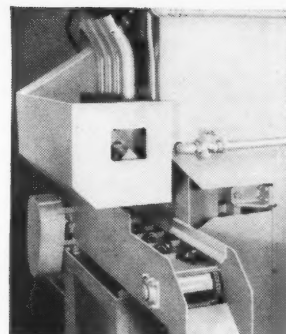
CHISHOLM NICHOLSON MACDONALD, president of the Gear Grinding Machine Co., Detroit, Mich., died on April 1.



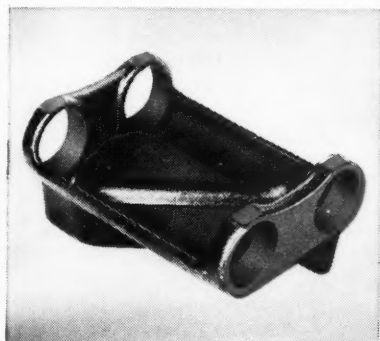
13,600 Splines/hour on one machine

The part: Steel forgings in which 17 internal splines of 1½" O.D. are to be broached.

The machine: A Colonial 20-ton 48" stroke Pull-up with multiple loading chutes, positioning shuttle and automatic ejector conveyor.



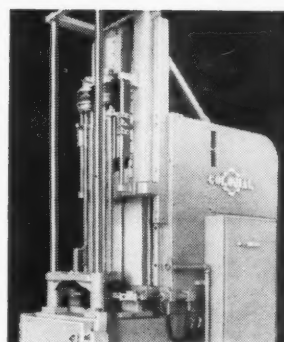
Colonials help you do **MORE JOBS** on **FEWER MACHINES**



12 Surfaces, 8 Bores on two machines

The part: Tank track forging requiring finishing of 6 flat surfaces and 4 bores in thin webs, broached two at a time.

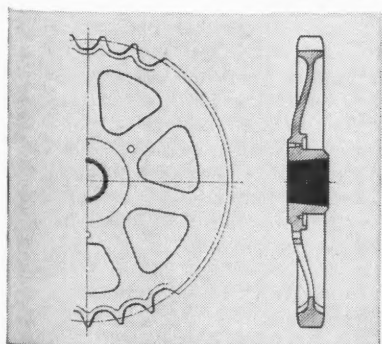
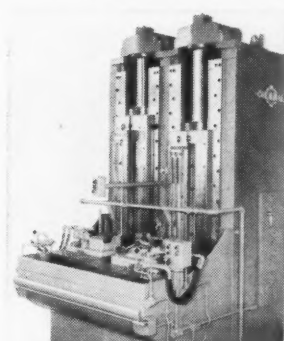
The machines: Colonial 25-ton Dual Ram for flat surfaces, Colonial Pull-down with automatic spreaders to support the part while broaching bores.



7 Surfaces, 4 Operations on two machines

The part: Tank track center guide to be completely machined as shown.

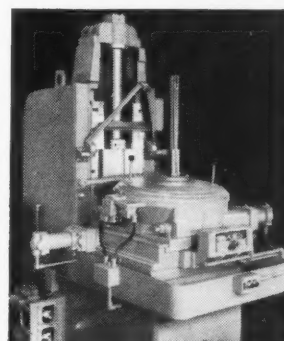
The machines: Two 25-ton Dual Ram machines perform all operations, produce one guide for each machine cycle.



Large Tapered Splines Broached in One Setup

The parts: Tractor wheel hubs, (several sizes).

The machine: Colonial 15-ton Pull-down equipped with special angular short-shuttle table, and automatic index.



For further information on the examples shown here, ask for Broaching News, Volume XIV, No. 1

New Books and Publications

TREATISE ON POWDER METALLURGY (VOLUME III). By Claus G. Goetzel. 899 pages, 6 by 9 inches. Published by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Price, \$22.

This book completes a series of three books on powder metallurgy, the first two being entitled "Technology of Metal Powders and Their Products" and "Applied and Physical Powder Metallurgy." Volume III is a classified and annotated bibliography covering literature and patents in this field.

The bibliography contains references up to January 1, 1950, with the addition of some literature items published in 1950. The author has compiled this comprehensive book in the hope that it will prove useful to the researcher and technical worker, the industrialist and plant engineer, the inventor and patent attorney and the librarian and general student of powder metallurgy.

This volume consists of two parts, Part I comprises the classified and annotated literature collection, 5535 separate items, in all, being noted. They are arranged in five sections: Powder Metallurgy—General; Production and Composition of Powders; Powder Processing Methods and Equipment; Powder Metallurgy Products—Their Composition, Properties, and Manufacture; and Theoretical Discourses. The references listed cover material published not only in this country but abroad; the comments on each item are limited to one or two concise statements.

Part II consists of a patent reference collection, 6330 patents being mentioned with a brief description of each. The year given is that of the issue of the patent. In the American patent citations, the inventor is given, and where possible, the assignee. In all other countries, the companies owning the patent are named where published at the head of the patent. The Patent Survey contains the following sections: Production and Composition of Powders; Powder Processing Methods and Equipment; and Powder Metallurgy Products, Their Compositions and Manufacture.

The table of contents, patent cross index, subject index, and name index are aimed to aid the reader searching for specific references.

THE SCIENCE OF PRECISION MEASUREMENT. 256 pages, 6 by 9 inches. Published by the DoAll Co., Des Plaines, Ill. Price, \$3.50.

Dimensional quality control, so necessary to our system of mass production, has become a science, the

knowledge of which is still limited. The purpose of this book is to show industry how to get more effective use from precision measuring instruments, in order to increase manufacturing profits and maintain quality production. Practical procedures to be followed in utilizing gage-blocks and the various gaging instruments, such as sine-bars, optical flats, electric comparators, straightedges, squares, height gages, etc., are expounded; the terms "clearance" and "tolerance" are explained; and methods of measuring and establishing angles, surface flatness, and parallelism are described.

The book introduces a new method of measurement using optical flats and the "visible scale" which enables surface flatness, finish, etc., to be determined to millionths of an inch. Also covered are recommended procedures for statistical sampling of parts for dimensional quality control and a discussion of mobile inspection systems for checking working gages and parts right at the point of production.

The DoAll manual is intended as a guide to men in industry responsible for inspection and dimensional quality control and as a text for students and apprentices in vocational schools and shops. To make the fundamental's more easily understood, simple charts, diagrams, and photographs illustrate the subject matter. Mathematical tables and a glossary complete the book.

THE WELDING OF NON-FERROUS METALS By E. G. West. 553 pages, 5 1/2 by 8 3/4 inches; 273 illustrations. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, \$8.50.

The purpose of this book is to place on record basic information on the application of the various welding processes to the non-ferrous metals. Since welding is a metallurgical procedure conducted habitually by those who are not metallurgists, the author has presented in detail the procedures to be followed by craftsmen whose metallurgical knowledge may be small, but who practice welding. No attempt is made to describe in detail all the processes, but brief descriptions of the processes and equipment are included because the author believes that the fundamental reasons for the adoption of particular procedures should be understood by the welder.

The first five chapters of the book are devoted to weldability, properties important in welding, fusion welding processes, resistance welding processes, and pressure welding. Then

six specific metals and their alloys—aluminum, magnesium, copper, nickel, lead, and zinc—are handled individually in six separate chapters, as the problems to be faced in welding and the techniques that must be developed vary with the different metals. Finally, the subjects of the welding of low melting point, high melting point, and precious metals are discussed.

ELECTRONIC FUNDAMENTALS. By A. Pritchard Lipscombe (No. 28 in the Yellow Back Series). 62 pages, 5 1/2 by 8 1/2 inches. Published by the Machinery Publishing Co., Ltd., National House, West St., Brighton 1, England. Sold in the United States by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price, 75 cents.

Within the last few years electronics has shown its versatility with respect to machine shop operations. The purpose of this book is to give mechanical engineers a general idea of the basic electronic devices and their function in industrial circuits. Accordingly, the book contains a brief account of direct current and alternating current, followed by descriptions of various important electronic devices—notably, the electronic valve, or tube, and its main modifications. The information given is intended to serve as an introduction to a companion volume on electronic applications.

EXHAUST HOODS. By J. M. DallaValle. 141 pages, 6 by 9 inches; 127 illustrations and 30 tables. Published by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price, \$3.50.

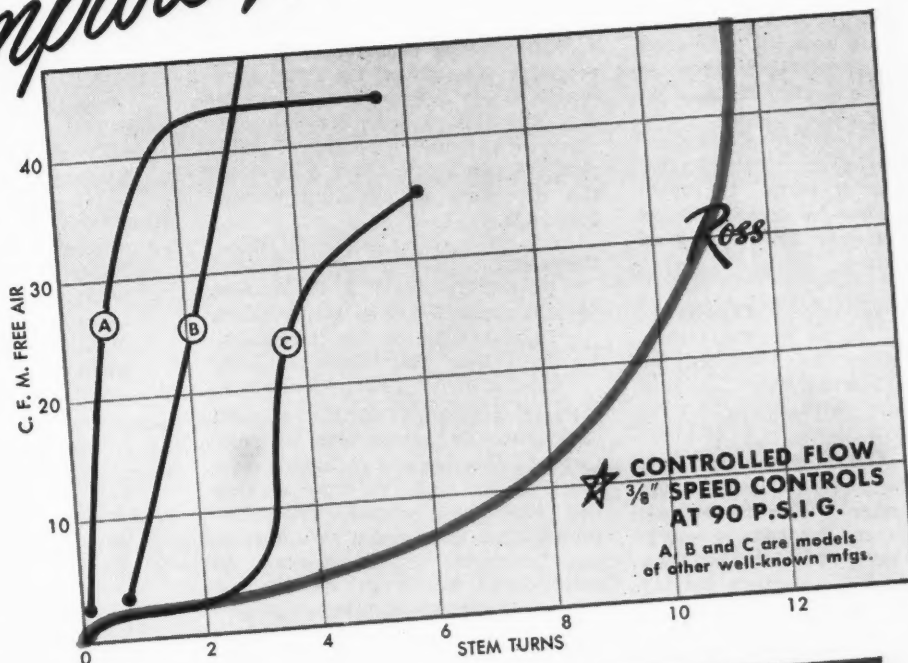
For information on exhaust hood design, this book is a primary source of data, based on experimental investigations on the flow of air around and into the openings in exhaust ventilating systems. It is a concise assembly of both fundamental theory and of practical applications of theory to the actual design of hoods for all types of industrial installations.

Originally published as a series of reports of the author's extensive research into the subject, the basic material has been considerably expanded in this second edition, and has been coordinated with data by other investigators covering hood, booth, and slot design.

COMPOUND CHANGE-GEAR AND INDEXING PROBLEMS. 76 pages, 5 1/2 by 8 1/2 inches. Published by the Machinery Publishing Company, Ltd., National House, West St., Brighton 1, England. Sold in the United States by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price, 75 cents.

(Continued on page 250)

Compare ★



★ **CONTROLLED FLOW**
★ **3/8" SPEED CONTROLS**
★ **AT 90 P.S.I.G.**

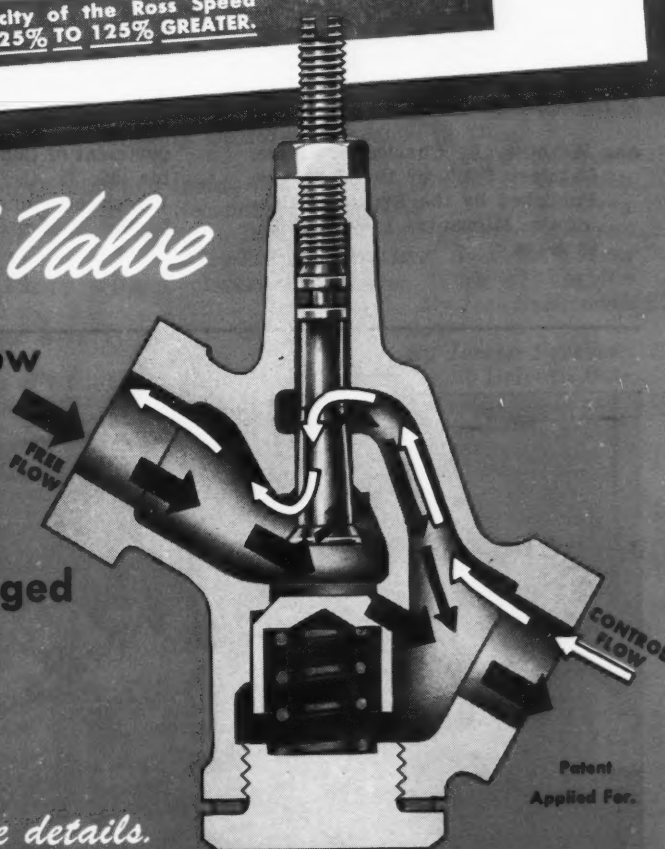
A, B and C are models
of other well-known mfgs.

★ Free flow capacity of the Ross Speed
Control Valve is **25% TO 125% GREATER.**

ROSS

Speed Control Valve

- ★ Easy-to-adjust control flow
- ★ Maximum free-flow
- ★ Simple, dependable, rugged
- ★ Small, lightweight



Write for complete details.

ROSS
Control
VALVES

ROSS OPERATING VALVE COMPANY

120 E. GOLDEN GATE AVE., DETROIT 3, MICHIGAN

MACHINERY, May, 1952—249

In this new addition (No. 27) to MACHINERY's Yellow Back Series, various arithmetical methods are presented for finding a suitable compound gearing combination for a given ratio, illustrated by a number of fully worked out examples, based on machine shop practice. The book forms a comprehensive introduction to change-gear calculations, and at the same time, will be found of considerable help to those already experienced who have difficult change-gear problems to solve. It covers change-gear ratios for lathes, milling machines, and gear generating and hobbing machines.

CORROSION TESTING. By Francis L. LaQue. 89 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price (paper-bound), \$1.50.

The 1951 ASTM Edgar Marburg Lecture, published in booklet form, comprises a survey of corrosion-testing programs and methods of corrosion testing, many of which have been sponsored by the American Society for Testing Materials. In this general review of methods, attention has been focussed on precautions that must be observed in planning and executing tests — particularly in interpreting the results. The author is in charge of the Corrosion Engineering Section, Development and Research Division, of the International Nickel Co.

ARC WELDING. By Charles H. Zielke. 63 pages, 8 1/4 by 10 1/2 inches. Published by the Bruce Publishing Co., Milwaukee 1, Wis. Price, 80 cents.

The text in this book on arc-welding is based on the author's experience both as a welder and as an instructor of welding. The material is presented in the form of lessons, which give the tools, equipment, and materials required for the particular operation being considered, and the procedure to follow. Each lesson is followed by questions to test the student's knowledge. The lessons cover all the different types of welds produced by arc welding, as well as the procedure for welding various materials.

COPYRIGHT, DESIGN, AND PATENT GUIDE. By Henry J. E. Metzler. 125 pages, 5 1/2 by 8 1/2 inches. Published by the Ameliorant Co., Inc., Box 108, Halesite, Long Island, N. Y. Price, \$2.

Basic principles of the present copyright and patent laws are outlined in this book, and helpful suggestions are made to those seeking the proper type of protection. The information is intended to aid authors, inventors, and businessmen in determining which of the various types of protection available—patent, copyright, or design protection—is best suited for a specific work, article, or the like. The author is a registered patent attorney.

ELECTRIC STEEL INGOT PRACTICE FOR SEAMLESS TUBE MANUFACTURE. 15 pages. Published by Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Price, 50 cents (check or money order payable to the Treasurer of the United States).

HOW TO RUN A METAL-WORKING SHAPER. 32 pages. Published by the South Bend Lathe Works, South Bend 22, Ind. Price, 25 cents.

Over sixty-five photographs, diagrams, and exploded views show the internal parts of a shaper, how to grind differently formed tool bits for shaper cuts, and how to handle the many job set-ups used in shaper work. The South Bend 7-inch shaper is the subject of this manual.

HOW TO IMPROVE ENGINEERING-MANAGEMENT COMMUNICATIONS. 48 pages. Published by the National Society of Professional Engineers, 1121 15th St., N. W., Washington 5, D. C. Price, \$2, non-members; \$1, members.

Survey showing how lack of adequate communications between company managements and their engineers wastes engineering man-power.

AMERICAN STANDARD SQUARE AND HEXAGON BOLTS AND NUTS, ASA B18.2—1952 (Revised). 35 pages, 8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price, \$2.

* * *

The Wright Brothers Medal, an award of the Society of Automotive Engineers, was presented to O. A. Wheelon, design engineer with the Douglas Aircraft Co., for the best paper read in 1951 before the Society on airplane design. The paper was entitled "Design and Manufacturing Techniques with Titanium."



Basic training for customers' machine operators and new machine tool and cutting tool specialists of DoAll sales corporation is provided at the DoAll Training School in Des Plaines, Ill. Assembly and alignment procedures are studied and practical experience in the operation and application of machines is obtained. Plant tours are combined with shop and classroom work.